97-84088-19

U.S. Bureau of
Reclamation

Federal irrigation projects

Washington

1930

97-84088-19
MASTER NEGATIVE #

COLUMBIA UNIVERSITY LIBRARIES
PRESERVATION DIVISION

BIBLIOGRAPHIC MICROFORM TARGET

ORIGINAL MATERIAL AS FILMED - EXISTING BIBLIOGRAPHIC RECORD

308
Z
Box 359 U.S. Bureau of reclamation.
...Federal irrigation projects. Washington, U.S. Govt.print.off., 1930.
83 p. illus., map. 23cm.

At head of title: United States Department of the interior... Bureau of reclamation...

D628.1
Un326
Copy in Egleston Library. 1930.

406206

UP COPY

RESTRICTIONS ON USE: *Reproductions may not be made without permission from Columbia University Libraries.*

TECHNICAL MICROFORM DATA

FILM SIZE: 35mm
REDUCTION RATIO: 11:1
IMAGE PLACEMENT: IA [✓ IIA] IB IIB

DATE FILMED: 5/15/97
INITIALS: TLM

TRACKING # : 24545

FILMED BY PRESERVATION RESOURCES, BETHLEHEM, PA.

INTENTIONAL
SECOND
EXPOSURES DUE TO
PHOTOGRAPHS

p. 30

U.S. DEPARTMENT OF THE INTERIOR

FEDERAL IRRIGATION PROJECTS

HOOVER DAM, BOULDER CANYON PROJECT

BUREAU OF RECLAMATION

308
Z
Box 359

f. 50

U. S. DEPARTMENT OF THE INTERIOR

FEDERAL IRRIGATION PROJECTS

HOOVER DAM, BOULDER CANYON PROJECT

BUREAU OF RECLAMATION

304
Z
Box 359

HOMES AND SCHOOLS

1. FARM HOME
BELLE FOURCHE PROJECT, SOUTH DAKOTA

2. FARM HOME
MINIDOKA PROJECT, IDAHO

3. RURAL SCHOOL
YAKIMA PROJECT WASHINGTON

4. HIGH SCHOOL
YAKIMA PROJECT WASHINGTON

5. HIGH SCHOOL
ORLAND PROJECT, CALIFORNIA

6. FARM HOME
BOISE PROJECT, IDAHO

UNITED STATES DEPARTMENT OF THE INTERIOR
RAY LYMAN WILBUR, Secretary
BUREAU OF RECLAMATION
ELWOOD MEAD, Commissioner

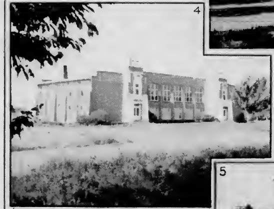
FEDERAL IRRIGATION PROJECTS

UNITED STATES
GOVERNMENT PRINTING OFFICE
WASHINGTON: 1930

HOMES AND SCHOOLS

1. FARM HOME
BELLE FOURCHE PROJECT, SOUTH DAKOTA

2 FARM HOME
MINIDOKA PROJECT, IDAHO



3. RURAL SCHOOL
YAKIMA PROJECT WASHINGTON

4 HIGH SCHOOL
YAKIMA PROJECT WASHINGTON

5 HIGH SCHOOL
ORLAND PROJECT, CALIFORNIA

6. FARM HOME
BOISE PROJECT, IDAHO

UNITED STATES DEPARTMENT OF THE INTERIOR
RAY LYMAN WILBUR, *Secretary*
BUREAU OF RECLAMATION
ELWOOD MEAD, *Commissioner*

FEDERAL IRRIGATION PROJECTS

UNITED STATES
GOVERNMENT PRINTING OFFICE
WASHINGTON : 1930

Agricultural and climatic conditions on Federal irrigation projects

State	Project	Elevation above sea level	Temperature range	Length of irrigation season	Principal products
		Feet	*Degrees*		
Arizona	Salt River	1,200	20–117	All year	Cotton, alfalfa, grain, cantaloupes, grapes, figs, citrus fruits, winter vegetables, lettuce, livestock, poultry, dairy products.
Arizona-California.	Yuma	80–140	25–117	do	Cotton, alfalfa, winter vegetables, lettuce, melons, small grains, pecans, livestock.
Arizona	Yuma Auxiliary.	155–215	29–117	do	Citrus fruits.
California	Orland	180–330	19–116	February to November,	Alfalfa, milo, citrus and other fruits, nuts, poultry, dairy products.
Colorado	Grand Valley	4,700	−15–100	Apr. 1 to Oct. 31.	Fruit, alfalfa, potatoes, sugar beets, beans, grains, tomatoes, livestock, poultry.
Do	Uncompahgre.	4,900–6,400	−10–96	do	Alfalfa, grains, potatoes, onions, apples, sugar beets, livestock, poultry.
Idaho	Boise	2,500	0–100	Apr. 5 to Oct. 5.	Alfalfa, grains, clover seed, potatoes, onions and other vegetables, apples, prunes, and other fruit, livestock, poultry.
Do	King Hill	2,600	0–115	Apr. 1 to Oct. 15.	Alfalfa, clover, alfalfa and clover seed, grains, early vegetables, beans, livestock, poultry.
Do	Minidoka	4,225	10–100	Apr. 1 to Oct. 15.	Potatoes, alfalfa, grains, sugar beets, livestock, poultry.
Montana	Huntley	3,000	−35–105	May 1 to Sept. 30.	Sugar beets, beans, alfalfa, grains, potatoes, small fruits, vegetables, melons, livestock, dairy products, poultry.
Do	Milk River	2,200	−40–100	Apr. 16 to Sept. 30.	Alfalfa, grains, vegetables, sugar beets, potatoes, livestock.
Do	Sun River	3,900	−40–100	May 1 to Oct. 10.	Alfalfa, sweetclover, grains, vegetables, seeds, livestock, and dairy products.
Montana-North Dakota.	Lower Yellowstone.	1,900	−40–105	do	Alfalfa, sugar beets, grains, potatoes, beans, garden truck, berries, livestock, and dairy products.
Nebraska-Wyoming.	North Platte	3,800–4,200	−20–100	Apr. 1 to Sept. 30.	Alfalfa, sugar beets, grains, potatoes, livestock, and dairy products.
Nevada	Newlands	4,000	0–105	Mar. 15 to Nov. 15.	Alfalfa, grains, vegetables melons, small fruits, poultry, livestock, and dairy products.
New Mexico	Carlsbad	3,100	−7–112	March to November.	Cotton, alfalfa, livestock, poultry.
New Mexico-Texas.	Rio Grande	3,600–4,100	10–104	Feb. 15 to Nov. 15.	Cotton, melons, fruits, vegetables, livestock, and dairy products.
Oregon	Umatilla	470	−37–115	Mar. 20 to Oct. 16.	Alfalfa, small fruits, corn, potatoes, melons, garden truck, livestock, poultry, and dairy products.
Do	Vale	2,250–2,500	−24–111	Apr. 5 to Oct. 5.	Alfalfa, grains, potatoes, onions, melons, head lettuce, turkeys.
Oregon-California.	Klamath	4,000–4,300	−16–105	Apr. 15 to Sept. 30.	Alfalfa, grains, potatoes, vegetables, livestock, and dairy products.
Oregon-Idaho	Owyhee	2,200–2,500	−26–113	Apr. 5 to Oct. 5.	Alfalfa, red clover, grains, potatoes, truck crops, livestock.
South Dakota	Belle Fourche	2,800	−38–103	May 1 to Oct. 1.	Alfalfa, sugar beets, grains, sheep, and dairy products.
Utah	Salt Lake Basin.	4,200–5,600	−10–95	Apr. 15 to Sept. 30.	Sugar beets, alfalfa, potatoes, berries, grains, tomatoes, vegetables and fruits, onions, melons, poultry, livestock, and dairy products.
Do	Strawberry Valley.	4,600	0–95	do	Alfalfa, grains, onions, sugar beets, potatoes, melons, fruits, livestock, and dairy products, poultry.
Washington	Okanogan	1,000	−10–108	May 1 to Oct. 1.	Apples, berries, grains, vegetables.
Do	Yakima	700–2,200	−28–110	Apr. 1 to Oct. 1.	Fruits, particularly apples and pears, potatoes, alfalfa, vegetables, berries, livestock, and dairy products.
Wyoming	Riverton	5,200	−30–102	May 1 to Sept. 30.	Alfalfa, potatoes, sugar beets, grains, vegetables, livestock, poultry.
Do	Shoshone	4,500	−34–101	Apr. 10 to Nov. 1.	Alfalfa, beans, sugar beets, potatoes, grains, livestock, and dairy products, poultry.

TABLE OF CONTENTS

Page

The reclamation act and its achievements ... 1
  Need for reclamation ... 1
  Results on existing projects ... 1
Engineering works ... 2
  Tunnels and siphons ... 2
  Dams ... 3
  Stony Gorge Dam ... 3
  Black Canyon Dam ... 3
  American Falls Dam ... 4
  Gibson Dam ... 4
  Owyhee Dam ... 5
  Shoshone Dam ... 7
  Boulder Dam ... 7
Financing construction ... 8
Project costs and public notices ... 9
Repayment of construction cost ... 10
  Without interest ... 10
  Ten-year act ... 10
  Twenty-year act ... 10
  Payment on crop production basis ... 11
  Forty-year act ... 11
  Temporary water service ... 11
Warren Act lands ... 12
Operation and maintenance ... 12
  By Bureau of Reclamation ... 12
  By water users ... 13
How to acquire land ... 13
  Public land ... 13
  Privately owned land ... 14
Additional information ... 14
Project offices ... 15
Opportunities for settlers ... 15
  The use of interest-free capital ... 15
  Variety of climatic and soil conditions ... 15
  Settler should choose ... 16
  Capital required ... 16
  Cost of developing raw land ... 16
  Available farms ... 17
Hints to settlers ... 18

Page
Methods of applying irrigation water 19
  Flooding 19
  The border method 19
  Corrugations 20
  The furrow method 22
  Basin and dike method 22
Arizona, Salt River project 24
Arizona-California, Yuma project 25
California, Orland project 28
Colorado River, Boulder Canyon Project 30
Colorado, Grand Valley project 31
Colorado, Uncompahgre project 33
Idaho, Boise project 35
Idaho, King Hill project 37
Idaho, Minidoka project 38
Montana, Huntley project 43
Montana, Milk River project 44
Map of projects 44–45
Montana, Sun River project 47
Montana-North Dakota, Lower Yellowstone project 50
Nebraska-Wyoming, North Platte project 51
Nevada, Newlands project 55
New Mexico, Carlsbad project 57
New Mexico-Texas, Rio Grande project 58
Oregon, Umatilla project 61
Oregon, Vale project 62
Oregon-California, Klamath project 65
Oregon-Idaho, Owyhee project 67
South Dakota, Belle Fourche project 68
Utah, Salt Lake Basin project 71
Utah, Strawberry Valley project 73
Washington, Okanogan project 74
Washington, Yakima project 76
  Kittitas division 77
Wyoming, Riverton project 80
Wyoming, Shoshone project 81

FEDERAL IRRIGATION PROJECTS

THIS booklet is published to give information to inquirers generally regarding the irrigation projects of the Bureau of Reclamation. Further information may be obtained from the Bureau of Reclamation, Washington, D. C., or by addressing project superintendents, a list of whom, with their addresses, is given on page 15.

THE RECLAMATION ACT AND ITS ACHIEVEMENTS

The reclamation act was approved June 17, 1902. Congress passed this act in order that large areas of lands suitable for irrigation farming in the arid States might provide homes for citizens, increase the agricultural area of the country and make beneficial use of two of its national assets, land and water.

Need for reclamation.—The early pioneer could with a team and plow and a few days' work divert the water from small streams to the bottom lands and produce good crops by irrigation. Within a short period of time these streams were fringed with farms and the development of water for irrigation became more difficult and costly. Lands adjacent to the developed areas were often on higher benches and were equal or sometimes better in quality than the lower-lying areas. Such lands could be irrigated only by the construction of diversion dams, storage works, and large canal systems. Such works, constructed by the United States Government, together with the lands served with water, all located in a more or less compact area, are known as Federal irrigation projects.

Results on existing projects.—There are 28 projects, located in whole or in part in 15 of the arid States. On June 30, 1929, 27 years after the passage of the reclamation act, a volume of water had been impounded in reservoirs or diverted from regular stream channels sufficiently large to irrigate 1,922,330 acres of project lands, and to furnish supplemental irrigation under the Warren Act of February 2, 1911, to 1,480,040 acres of land having an insufficient water supply for full crop production. The average acre value of the crops produced during 1929 was $60, or a total crop value from land receiving water from Federal project works of $161,179,880. This crop value of $161,179,880 represents approximately 80 per cent of the total cost of construction on all the reclamation projects. During the existence of the Bureau of Reclamation more than $1,642,000,000 worth of crops has been produced on the projects.

The value of livestock in 1929 on the 24 operating projects under the supervision of the bureau was $26,420,689, and that of farming equipment $16,246,570, or a total stock and equipment value of $42,667,259.

Serving the projects and adjacent areas are 17 beet-sugar factories which in 1928 produced more than 500,000,000 pounds of sugar and paid $12,800,000 for beets, about $5,500,000 having been paid to water users on Federal projects. Shipments to 17 of the 24 operating projects in 1928 numbered 95,496 carloads, valued at $119,619,000 and shipments from stations on these projects totaled 112,608 carloads valued at $158,295,000.

The lands on the projects, brought under irrigation by the efforts of the bureau, excluding Warren Act lands for which statistics are not available, have been divided into 40,788 farms on which live 153,663 individuals. In addition there are 212 towns and cities on or adjacent to the projects, with a population of 451,811, a considerable part of which derive their support indirectly from the activities of these projects. There are also on the projects 687 schools, 689 churches, 136 banks, and a great variety of manufacturing enterprises which make use of the products of the projects.

ENGINEERING WORKS

The Bureau of Reclamation at the close of 1929 had constructed 52 storage dams and had 3 under construction, with a total volume of 23,822,710 cubic yards, and 49 diversion dams, with 2 under construction, containing 1,189,500 cubic yards. The storage reservoirs have a combined capacity of 14,618,320 acre-feet of water, or 4,763,394,000,000 gallons. In addition to these dams, 13 storage and 9 diversion dams have been built by the bureau on Indian irrigation projects. The completed canal systems include 16,557 miles of canals, ditches, and drains, 148,462 canal structures, 11,631 bridges, 14,043 culverts, 4,811 flumes, 1,203 miles of roads, 3,350 miles of telephone line, and 2,056 miles of transmission line. Excavation of earth, rock, and indurated material amounts to 276,822,500 cubic yards.

Tunnels and siphons.—The construction of many important engineering works has been necessary in order to carry water to the irrigated lands. The Gunnison Tunnel, on the Uncompahgre project in Colorado, brings water from the Gunnison River to supplement the flow of the Uncompahgre River. The tunnel in cross section is 10½ by 11½ feet, is 6 miles long, and has a capacity of 1,200 second-feet. On the Yuma project, Arizona-California, the main canal is taken under the Colorado River from the California side to the Yuma Valley lands on the Arizona side, through a 14-foot diameter siphon 965 feet long. The present construction of the distribution system on the Kittitas division of the Yakima project, Washington, involves many important structures, including large siphons and tunnels. The main canal from the diversion dam at Easton to the Yakima River crossing near Swank has a large amount of concrete and gunite lining and 7 siphons. Of the latter the Morrison Canyon siphon is 552 feet long and consists of a monolithic reinforced concrete pipe 12 feet 1 inch diameter connected to the inlet and outlet structures at the ends and extending down the sides of the canyon to a point where the pressure head is about 115 feet. The siphon between the ends of the reinforced concrete pipe is of riveted plate steel, the maximum pressure head being 238 feet. The main canal crosses the Yakima River through a concrete-lined pressure tunnel 9 feet 3 inches inside diameter, with an over-all length, including inclined shafts, of 3,596 feet and head of approximately 500 feet.

At Boulder Dam four diversion tunnels, each 50 feet in diameter, will be constructed at a total cost of $18,000,000. Two of these tunnels will be used to deliver water to the power penstocks connected to the turbines at the power plant.

On the Owyhee project, Oregon-Idaho, in order to get water out of the Owyhee River Canyon to the irrigable lands, it is necessary to construct tunnels to cost about $4,000,000. The main canal on the Vale project in Oregon will be 75 miles in length and also involves tunnel construction. On the Gooding division of the Minidoka project, Idaho, a 70-mile main canal takes out at the Milner Dam on the Snake River and delivers water to lands near Gooding and Shoshone.

Dams.—Some of the storage dams that have recently been constructed or are now being constructed are illustrated and described herein.

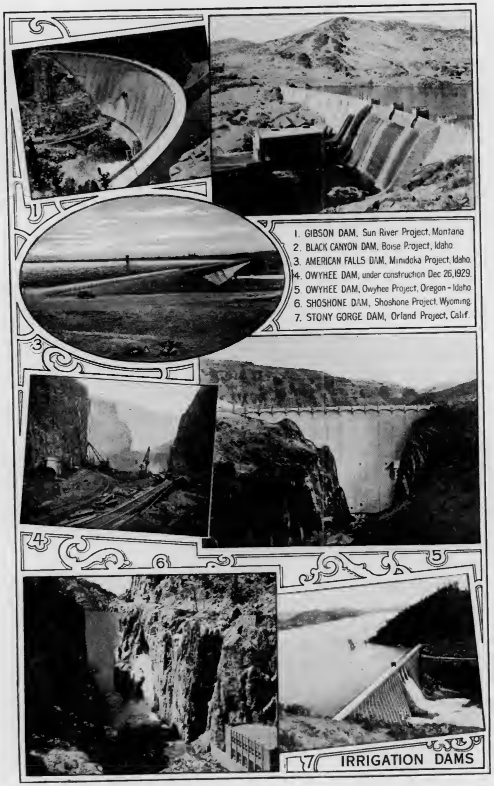
Stony Gorge Dam.—The Stony Gorge Dam, forming Stony Gorge Reservoir, is located on Stony Creek, about 22 miles southwest of Orland, Calif. The reservoir, with a capacity of 50,200 acre-feet and an area of 1,270 acres, is one of the two storage reservoirs on the Orland project. The dam is the noncontinuous, reinforced, Ambursen type, with a maximum height of 142.5 feet, a crest length of 868 feet, and contains 43,135 cubic yards of concrete. Spillway facilities are provided through three bays of overflow section in the central portion of the structure and consist of three 30 by 30 foot inclined gates—operated by electric motors—controlling the upper 20 feet of water depth in the reservoir. The normal operating capacity of the spillway is 30,000 second-feet, with a maximum capacity of 50,000 second-feet. Stony Gorge is the largest dam of the Ambursen type constructed by the Bureau of Reclamation; it is also one of the few dams of this type built on the Pacific coast. Construction was completed in October, 1928, after two years' work, at a cost of $1,055,000.

Black Canyon Dam.—The Black Canyon Dam, on the Boise project, Idaho, diverts water to 22,000 acres in the Emmett irrigation district. It also provides for possible future diversions to 56,000 acres of irrigable land in the Payette division of the Boise project. The dam is located at the mouth of the Payette River Canyon, about 7 miles above Emmett, Idaho, and is a concrete gravity structure with a crest length of 1,134 feet and a height of 184 feet. It consists of an overflow section at the river channel and abutment sections on the sides. Both abutment sections are straight, but the overflow section is made up of three straight sections intersecting at angles of 6 degrees 50 minutes at the two central piers and meeting the abutment sections at angles of 3 degrees 25 minutes, thus providing a slight amount of arch effect. The total length of the overflow section is 218 feet between training walls, and the net length of the spillway crest is 192 feet, separated by piers into three 64-foot lengths. These lengths are fitted with 64 by 14 foot 6 inch automatically operated drum gates. When the gates are entirely lowered a flood of 40,000 second-feet can be discharged. The dam was built by Government forces at a cost of $1,492,305 and was completed in June, 1924. A power plant has been built since the dam was completed and the equipment consists of two 5,000 kv.-a. generators direct connected to 6,000-horsepower vertical-shaft hydraulic turbines.

American Falls Dam.—The American Falls Dam, located on the Snake River near the city of American Falls, Idaho, was built for the purpose of supplying additional storage for irrigation in the Snake River Valley. It is a concrete gravity structure, with rolled earth-fill embankments at the ends, having a total length of approximately 1 mile and a maximum height of 87 feet. The reservoir created by the dam is 25 miles long and 12 miles wide, with an area of 56,200 acres and capacity of 1,700,000 acre-feet. The stored water is used to augment the supply of numerous existing canals serving a total area of approximately 600,000 acres, located both above and below the reservoir, the lands above the reservoir being benefited through the exchange of American Falls storage for Jackson Lake storage. The American Falls storage will supply about 170,000 acres of irrigable land in the Minidoka project. Construction of the dam was begun in February, 1925, and completed in September, 1927, at a cost of $3,060,000.

Gibson Dam.—The Gibson Dam is on the North Fork of Sun River, about 80 miles west of Great Falls, Mont. It is of the massive concrete arch type, with a maximum height of 195 feet, a crest length of 900 feet, and contains 160,000 cubic yards of concrete. About 3 miles below the Gibson Dam is the Sun River diversion dam, which is the point of diversion of all water for the 90,000 acres of irrigable land of the Sun River project lying north of Sun River. The spillway of the Gibson Dam is located in the north abutment and provides for discharge of 50,000 second-feet by means of an uncontrolled circular lip discharging into a vertical shaft and in turn into a tunnel leading to the river below the dam. Provision has been made in the design so that drum gates may be installed on the spillway at some later date, thus increasing the storage capacity of the reservoir from 90,000 to 105,000 acre-feet, without raising the crest of the dam above elevation 4725.5. Two outlets for irrigation water through the central portion of the dam are controlled by 60-inch balanced needle valves, supplemented by 5 by 5 foot high-pressure emergency gates. Excavation at the dam site was started in December, 1927, and the dam was completed in July, 1929. The cost of the dam and appurtenant works was approximately $2,300,000.

Owyhee Dam.—From an engineering standpoint the Owyhee Dam, now under construction, on the Owyhee River in eastern Oregon, is one of the most outstanding dams undertaken by the Bureau of Reclamation. With a height of 405 feet at maximum section and a total height of 520 feet above the lowest concrete in the foundation cut-off, this structure is likely to stand as the highest dam in the world until the Boulder Dam is completed. It will be of the concrete arch-gravity type, with a crest length of 850 feet, top thickness of 30 feet, and bottom thickness at maximum section of 265 feet. There will be 490,000 cubic yards of concrete in the dam. The sluice-gate outlet will consist of three outlet conduits, each conduit being controlled by two 4 by 5 foot cast-iron sluice gates arranged in tandem alignment. The needle-valve outlet will consist of three cast-iron lined conduits, each conduit to be controlled by a 48-inch balanced needle valve and a 4 by 4 foot high-pressure emergency gate. Power penstock outlets will consist of two 6-foot conduits, each controlled by a 5 by 6 foot cast-iron emergency gate. The penstock tunnel and power plant are not to be constructed at this time. The greater part of the 22-foot diameter horseshoe tunnel, for river diversion during construction, will be utilized for the permanent spillway. The spillway will consist of a vertical shaft connecting with the diversion tunnel. A 60 by 12 foot ring gate operating in an annular pressure chamber formed in the spillway crest structure will control the spillway shaft. The operation of the ring gate will be controlled automatically by a needle-type valve in the same manner as recent drum-gate installations. The reservoir formed by the dam will be 40 miles in length and will store 715,000 acre-feet of water for the irrigation of 122,000 acres of land in the Owyhee project, Oregon-Idaho. A railroad for transporting construction materials has been built from the Oregon Short Line Railroad near Dunaway Siding, Oregon, to the dam site, a distance of 24 miles. Work on the dam was begun in August, 1928, and the structure will be completed in 1932. The estimated cost of the dam and appurtenant works will be about $6,700,000.

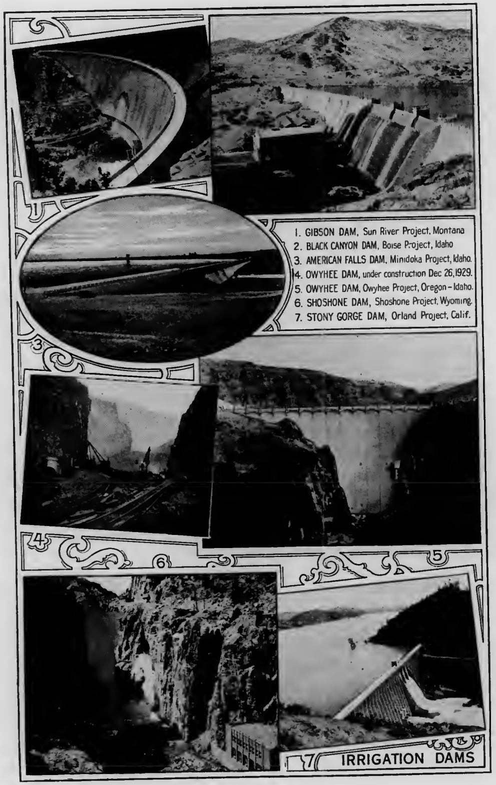


1. GIBSON DAM, Sun River Project, Montana
2. BLACK CANYON DAM, Boise Project, Idaho
3. AMERICAN FALLS DAM, Minidoka Project, Idaho.
4. OWYHEE DAM, under construction Dec 26, 1929.
5. OWYHEE DAM, Owyhee Project, Oregon - Idaho.
6. SHOSHONE DAM, Shoshone Project, Wyoming.
7. STONY GORGE DAM, Orland Project, Calif.

IRRIGATION DAMS

Shoshone Dam.—The Shoshone Dam is located 8 miles from Cody, Wyo., on Shoshone River, near the upper end of Shoshone Canyon. The dam is a monolithic rubble structure of the arch type. From foundation rock to the top of the parapet the maximum height is 328 feet. In design the Shoshone Dam is similar to the Pathfinder in Wyoming, both being high structures in narrow granite gorges. At the dam site the canyon is 70 feet wide at the normal stream bed and 200 feet wide at an elevation of 300 feet above the stream bed. For a distance of 1,400 feet the granite walls continue with little divergence from perpendicular, and are surmounted by a limestone capping extending to over 4,000 feet above the stream bed. The dam has a top thickness of 10 feet, with a batter to stream-bed level of 15 per cent on the reservoir face and 25 per cent on the downstream face, both faces being vertical below the stream bed. The volume of masonry in the main structure is 75,000 cubic yards. On the north side of the reservoir, several hundred feet upstream from the dam, there is a concrete spillway weir 300 feet long, discharging into an open channel and thence into a tunnel 405 feet in length. The spillway capacity is about 21,000 second-feet. The dam, spillway, and tunnels cost approximately $1,000,000, and the total cost of the reservoir was about $1,400,000. The power plant contains two 1,000 kv.-a. and one 5,000 kv.-a. vertical hydro-electric units. Most of the power is sold commercially, a small amount being used on the project for construction purposes.

Boulder Dam.—The Boulder Dam to be constructed in Black Canyon on the Colorado River will be by far the highest dam in the world. The site is on the Arizona-Nevada State boundary line, about 25 miles southeast of Las Vegas, Nev., and 80 miles north of Needles, Calif. The dam will be about 707 feet in height above bedrock, with a crest length of about 900 feet, and will raise the water surface of the river approximately 582 feet. It will contain approximately 3,500,000 cubic yards of concrete. A reservoir of 30,500,000 acre-feet capacity will be formed by the dam. The reservoir will be 115 miles long, with an area of about 145,000 acres. The Boulder Canyon project act authorized the construction of three features—dam, power plant, and all-American canal. Plans for the power plant contemplate an installation of approximately 1,200,000 horsepower. There are about 1,800,000 acres of irrigable lands below the reservoir. It is estimated that the project will cost $165,000,000, divided as follows: Dam and reservoir, $70,600,000; power development, $38,200,000; all-American canal, $38,500,000; interest during construction, $17,700,000. A proposed Coachella Valley branch canal will cost an additional $11,000,000.



1. GIBSON DAM, Sun River Project, Montana
2. BLACK CANYON DAM, Boise Project, Idaho
3. AMERICAN FALLS DAM, Minidoka Project, Idaho.
4. OWYHEE DAM, under construction Dec 26, 1929.
5. OWYHEE DAM, Owyhee Project, Oregon-Idaho.
6. SHOSHONE DAM, Shoshone Project, Wyoming.
7. STONY GORGE DAM, Orland Project, Calif.

IRRIGATION DAMS

Shoshone Dam.—The Shoshone Dam is located 8 miles from Cody, Wyo., on Shoshone River, near the upper end of Shoshone Canyon. The dam is a monolithic rubble structure of the arch type. From foundation rock to the top of the parapet the maximum height is 328 feet. In design the Shoshone Dam is similar to the Pathfinder in Wyoming, both being high structures in narrow granite gorges. At the dam site the canyon is 70 feet wide at the normal stream bed and 200 feet wide at an elevation of 300 feet above the stream bed. For a distance of 1,400 feet the granite walls continue with little divergence from perpendicular, and are surmounted by a limestone capping extending to over 4,000 feet above the stream bed. The dam has a top thickness of 10 feet, with a batter to stream-bed level of 15 per cent on the reservoir face and 25 per cent on the downstream face, both faces being vertical below the stream bed. The volume of masonry in the main structure is 75,000 cubic yards. On the north side of the reservoir, several hundred feet upstream from the dam, there is a concrete spillway weir 300 feet long, discharging into an open channel and thence into a tunnel 405 feet in length. The spillway capacity is about 21,000 second-feet. The dam, spillway, and tunnels cost approximately $1,000,000, and the total cost of the reservoir was about $1,400,000. The power plant contains two 1,000 kv.-a. and one 5,000 kv.-a. vertical hydro-electric units. Most of the power is sold commercially, a small amount being used on the project for construction purposes.

Boulder Dam.—The Boulder Dam to be constructed in Black Canyon on the Colorado River will be by far the highest dam in the world. The site is on the Arizona-Nevada State boundary line, about 25 miles southeast of Las Vegas, Nev., and 80 miles north of Needles, Calif. The dam will be about 707 feet in height above bedrock, with a crest length of about 900 feet, and will raise the water surface of the river approximately 582 feet. It will contain approximately 3,500,000 cubic yards of concrete. A reservoir of 30,500,000 acre-feet capacity will be formed by the dam. The reservoir will be 115 miles long, with an area of about 145,000 acres. The Boulder Canyon project act authorized the construction of three features—dam, power plant, and all-American canal. Plans for the power plant contemplate an installation of approximately 1,200,000 horsepower. There are about 1,800,000 acres of irrigable lands below the reservoir. It is estimated that the project will cost $165,000,000, divided as follows: Dam and reservoir, $70,600,000; power development, $38,200,000; all-American canal, $38,500,000; interest during construction, $17,700,000. A proposed Coachella Valley branch canal will cost an additional $11,000,000.

FINANCING CONSTRUCTION

The reclamation act of 1902 provided that the funds obtained from the sale of public lands in 16 of the arid Western States should be used by the Secretary of the Interior for the examination and construction of Federal reclamation projects. Soon after the act became operative projects were selected and construction work began. The construction program adopted soon required all the funds made available by the act and an additional sum of $20,000,000 was needed, which was provided for by a loan from the United States Treasury under the act of June 25, 1910. This loan is being repaid at the rate of $1,000,000 a year under the act of June 12, 1917. Additional funds were made available by the mineral leasing act of February 25, 1920, and the reclamation fund was further supplemented from time to time by special acts in which funds were provided for special purposes.

The receipts from the sale of public lands have very nearly reached the vanishing point, receipts from mineral leases have been decreasing during recent years, and in the future reclamation activities must depend to a large extent on the collection of repayments from project water users of construction, operation and maintenance, and water rental charges.

The Government had invested up to June 30, 1929, about $186,000,000 in reclamation projects, and the total repayments amounted to approximately $36,350,000. The repayments for the fiscal year 1929 were $6,308,000, and although this may increase slightly, it furnishes a fairly good index of the rate of future construction activities.

It was the intent of the original reclamation act that the irrigation system should be constructed by the Government and turned over to the water users to be maintained at their expense under such form of organization and under such rules and regulations as might be acceptable to the Secretary of the Interior. At first an effort was made to accomplish this through water users' associations, but it was found that on most of the projects such associations experienced too many difficulties in collecting charges, whereas irrigation districts organized under the provision of State law have the necessary authority to levy and collect assessments. The act of May 25, 1926 authorizes the Secretary of the Interior to extend the time of payment of construction charges on existing projects, but not to exceed 40 years from the date the first payment matured under the original contract, with the proviso that a joint liability contract shall be executed with a water users' association or irrigation district providing for the payment to the United States of all charges becoming due on the productive irrigable land. On new projects it is also required that such a contract must be executed, and in the case of public land projects settlers are notified that if they wish to receive the benefits of the 40-year period of payments, they must, when, in the judgment of the Secretary of the Interior, a sufficient number of settlers have been secured, form an irrigation district or water users' association and execute a joint liability contract providing for the payment of charges on all of the productive land. Failure to proceed in the manner above outlined will make it necessary for the Secretary to require payment of construction charges within a period of 20 years, as provided in the act of August 13, 1914. It is the duty of the Secretary to give public notice when water is actually available.

PROJECT COSTS AND PUBLIC NOTICES

The reclamation act of June 17, 1902, provided that upon determination by the Secretary of the Interior that a project was practicable he could cause it to be constructed and then by public notice give the terms and conditions under which public lands might be entered or water-right applications accepted for lands in private ownership and the number of annual installments, not exceeding 10, in which the construction charges were to be paid and the time when such payments should commence. As projects were frequently separated into divisions, the cost was charged against each division in accordance with the works which served it, and the acreage cost of construction was not always the same for all farm units on a project. The extension act of August 13, 1914, provided for a payment period of 20 years.

After public notice was issued determining the acre cost of construction, the water users frequently requested that additional construction work be done by the bureau to make the irrigation system operate more efficiently or to provide needed improvements. In such cases the water users expressed themselves by signing individual agreements under section 4 of the act of August 13, 1914, and when such agreements were accepted by an order of the Secretary of the Interior the additional works were constructed, the cost thereof to be paid by the water users in accordance with their agreements as supplemental construction charges in addition to the original construction charge.

The act of December 5, 1924, provides that in the case of any new project or division of an old project that is being considered for construction, it is necessary to determine not only the engineering features and construction costs but also to make a thorough investigation and report covering the agricultural and economic facts, so that the solvency of the enterprise may be determined. If the project is considered favorably by the Secretary of the Interior, the construction program is then submitted to the President, and, if approved by him, Congress is asked to appropriate money from the reclamation fund to provide for its construction.

Under the provisions of the act of May 25, 1926, no water shall be delivered to any new project or new division of a project until a contract shall have been made with an irrigation district organized under State law providing for payment by the district of the construction cost and the operation and maintenance cost during the time the works are in control of the United States. The contract states definitely the total amount to be expended by the United States and this construction cost is to be repaid in such term of years as the Secretary may find to be necessary, in any event not more than 40 years from the date of public notice.

The law further provides that in connection with the settlement and development of projects the Secretary, in his discretion, is authorized to enter into agreement with the proper authorities of the State whereby such States shall cooperate with the United States in promoting the settlement of the project and securing and selecting settlers. Contracts with irrigation districts must provide for the appraisal and sale of private land held in excess of 160 acres on the basis of the actual bona fide value without reference to the proposed construction of the irrigation works. The intent of this provision is to eliminate speculation, which has had an adverse influence in the development of some projects.

REPAYMENT OF CONSTRUCTION COST

Without interest.—The reclamation act and amendments thereto provide that those who settle upon the reclaimed lands shall be required to repay in installments and without interest the money which has been expended in the construction of the works necessary to make water available to the farmer.

Ten-year act.—The reclamation act of June 17, 1902, provides that the construction cost shall be repaid in equal annual installments, not exceeding 10, beginning with the date specified in the public notice. Contracts under this repayment plan have paid out or have been changed to the 20-year plan.

Twenty-year act.—The extension act of August 13, 1914, provides that construction charges shall be repaid in 20 years, but there is a distinction between lands previously made subject to the reclamation act of June 17, 1902, and lands not subject to that act, as follows:

Section 1 applies to lands which were not subject to the conditions of the reclamation act prior to August 13, 1914, and provides that the construction charge per acre shall be paid by an initial installment of 5 per cent, due at the time application for entry is filed, and the balance in 15 annual installments, the first 5 of which shall each be 5 per cent and the remainder shall each be 7 per cent, until the whole amount shall have been paid. The first of the annual installments shall become due and payable on December 1 of the fifth calendar year after the initial installment and the remaining installments shall become due and payable on December 1 of each year thereafter.

Section 2 applies to lands which were subject to the terms and conditions of the reclamation act prior to August 13, 1914, and provides that 2 per cent of the construction charge shall be paid each of the first 4 years, 4 per cent each of the next 2 years, and 6 per cent each of the following 14 years. The first of the annual installments became due and payable on December 1 of the year in which the benefits of the extension act were formally accepted by the water users, and the remaining installments became due and payable on December 1 of each year thereafter.

Nine projects or divisions of projects are making payments under the provisions of the extension act.

Payment on crop-production basis.—The act of December 5, 1924, provided for payment of the construction charge at the rate of 5 per cent of the average gross annual acre income for the 10 calendar years first preceding, or for all years of record if fewer than 10 years are available, of the area in cultivation in the project, or a division thereof, in which the land is located, as found annually by the Secretary of the Interior. This plan is based on the productive capacity of the land. The Secretary of the Interior is authorized to fix different construction charges against different classes of land under the same project, or a division thereof, for the purpose of equitably apportioning the construction cost so that all lands may bear the burden of such cost according to their productive value. Project lands have been classified and each farm put in a definite class based on its productive capacity. This does not mean, however, that a farmer will be required to pay on his actual recorded annual crop return for his particular farm, but rather on the average crop return for the irrigable area of the class to which his farm belongs.

While the act of December 5, 1924, was in force 10 contracts were executed providing for the payment of construction charges on a crop-production basis. This provision was repealed by the act of May 25, 1926, which substituted the 40-year repayment plan.

Forty-year act.—Under the provisions of the act of May 25, 1926, the Secretary of the Interior is authorized to enter into a contract with irrigation districts providing for payment of the cost of constructing the project works within such term of years as he may find to be necessary, in any event not more than 40 years. Contracts have been executed on 12 projects or divisions of projects providing for repayment under the provisions of this act. These contracts differ somewhat in minor details. The project superintendent should be asked to give the exact terms of payment applying to a particular project or division of a project.

Temporary water service.—Where public notice has not been issued announcing the construction charge per acre, but an order has been issued making public lands available for entry, the settler pays for water on an annual rental basis. Payment of the construction charge in that event does not commence until public notice is issued providing for it. On some projects provision is made for the delivery of water on a rental basis during the construction period or until such time as an adequate supply of water has been made available. This general policy is followed on practically all projects during the development period. In case the receipts from water rentals do not equal the cost of operation and maintenance the deficit is added to the construction cost of the project. As soon as conditions warrant, the delivery of water on a rental basis is discontinued and operation and maintenance charges are fixed so as to cover the actual costs and are assessed against all productive lands, whether water is used or not.

WARREN ACT LANDS

It was found on some projects that a surplus of water had been developed over and above that needed by the lands of the project, which could be used to augment the supply for partially irrigated lands under private systems. Consequently, the act of February 21, 1911, was passed. This act provides that such surplus waters may be sold to adjacent and near-by lands, and also that the United States may cooperate with others in the construction and operation of dams and reservoirs which may be used to supply project lands and lands of the cooperating parties. Warren Act contracts have been made with irrigation districts, water users' associations, corporations, and individuals, but the terms of repayment are not the same in all the various contracts.

OPERATION AND MAINTENANCE

By Bureau of Reclamation.—The water used for irrigation requires careful and proper distribution to the farmers. The distribution of water causes the annual operation cost. The structures and canal systems built by the bureau represent a large outlay of money, but a greater value in the service they render to the farmers who must utilize them. These structures and canals must be cared for in the best possible manner. Expenditures for such purposes are known as the annual maintenance cost. The operation and maintenance costs, or O. & M. costs, are usually grouped together because the services overlap and the same organization looks after both. The charges to repay the O. & M. cost are payable yearly by the farmers and vary from year to year on each project, depending upon the amount of work done and the problems encountered. The charges are due and payable in advance, at or before the beginning of the irrigation season, as announced by the Secretary of the Interior.

By water users.—The farmers on the projects are organized into water users' associations or irrigation districts, and they elect their governing boards. It is the policy of the bureau to turn over the operation and maintenance of the projects to the farmers as soon as possible. This has already been done on 11 projects or divisions of projects and this number will be increased from year to year. Where it has not, a small assessment is levied to support a water users' association or a small tax is levied to support an irrigation district. These assessments, though small, must be paid in addition to the regular operation and maintenance charges.

HOW TO ACQUIRE LAND

The public notices previously referred to are issued by the Secretary of the Interior and give a list of the lands for which water is available.

Public land.—The applicant for public land shall be eligible to become an entryman under the homestead laws of the United States and prepared to conform to the rules and regulations of the Bureau of Reclamation. On some projects the construction charges have been announced; on others they have not. The title to public land remains in the United States until patent is issued, although the law permits assignment prior to issuance of patent; therefore public land may be acquired either by entry or assignment. The applicant should obtain definite information from the project superintendent in respect to units available and the conditions under which entry may be made. Water-right application forms, when required, will be supplied from the various projects upon request. Application forms for homestead entry may be obtained from the local land office.

The act of December 5, 1924, authorizes the Secretary of the Interior to require of each applicant, including preference right ex-service men, for entry to public lands on a project, such qualifications as to industry, experience, character, and capital as, in his opinion, are necessary to give reasonable assurance of success by the prospective settler. Any person who wishes to make homestead entry on a reclamation project must first appear before an examining board and submit a written statement giving his age, status of citizenship, whether married or single, number of children and their sex and ages, other dependents, ownership of farm lands elsewhere and the value thereof, farming experience, assets and liabilities, and give references as to character and industry. Applicants must possess good health and vigor and have had at least two years' actual experience in farm work and farm practice, and have at least $2,000 in money, free of liability, or the equivalent thereof in livestock, farming equipment, or other assets deemed by the examining board to be as useful as money. Homestead entries can not be filed until the applicant has been successfully passed by the examining board.

Privately owned land.—Privately owned land can be purchased in the various projects and is obtained similarly to purchasing such land elsewhere, except that purchasers must comply with the rules and regulations of the Bureau of Reclamation, particularly in regard to the payment of construction and operation and maintenance charges heretofore mentioned. Privately owned land located within the project boundaries may or may not be subject to the reclamation law, depending on whether the land is covered by water right application or by subscription for stock in a water users' association or is included in an irrigation district which has contracted with the United States.

On the Belle Fourche project in South Dakota, the Lower Yellowstone project in Montana-North Dakota, and the Orland project in California options have been obtained on a number of privately owned tracts of land. Booklets have been printed giving brief descriptions of such farms, with prices and terms of payment. Copies of these booklets, as well as any pertinent facts about private lands, will be furnished upon inquiry at the project office.

On the Kittitas division of the Yakima project in Washington, the Owyhee project in Oregon-Idaho, the Vale project in Oregon, and the Gooding division of the Minidoka project, Idaho, large tracts of private lands have been appriased by an independent board of appraisers, and in most cases contracts have been executed and placed of record giving prices and definite terms of sale for these lands. The reclamation law provides that water can not be furnished to land in a single ownership in excess of 160 acres in area, and the act of May 25, 1926, provides that excess land shall be appraised in a manner to be prescribed by the Secretary of the Interior and that no such excess land shall receive water if the owners shall refuse to execute valid recordable contracts for the sale of such lands under terms and prices considered satisfactory to the Secretary. This provision of law will have a tendency to hold down the price of all project lands. It is again emphasized that the project superintendent must be consulted to secure definite and detailed information regarding any particular tract of land.

ADDITIONAL INFORMATION

The available public lands and the opportunities for the purchase of privately owned land are continually changing on the projects. The Bureau of Reclamation issues information regarding these conditions to those requesting it. The project superintendents can furnish detailed information in regard to opportunities for settlers on their projects, and they should be addressed as given hereunder to obtain such information:

Project	Title	Address
Belle Fourche	Project superintendent, Bureau of Reclamation	Newell, S. Dak.
Boise	do	Boise, Idaho.
Boulder Canyon	Construction engineer	Las Vegas, Nev.
Carlsbad	Project superintendent, Bureau of Reclamation	Carlsbad, N. Mex.
Grand Valley	do	Grand Junction, Colo.
Huntley	Superintendent, Huntley project irrigation district	Ballantine, Mont.
King Hill	Manager, King Hill irrigation district	King Hill, Idaho.
Klamath	Project superintendent, Bureau of Reclamation	Klamath Falls, Oreg.
Lower Yellowstone	do	Savage, Mont.
Milk River	do	Malta, Mont.
Minidoka	do	Burley, Idaho.
Newlands	Project manager, Truckee-Carson irrigation district	Fallon, Nev.
North Platte	Superintendent of power	Guernsey, Wyo.
Okanogan	Superintendent, Okanogan irrigation district	Okanogan, Wash.
Orland	Project superintendent, Bureau of Reclamation	Orland, Calif.
Owyhee	Construction engineer	Owyhee, Oreg.
Rio Grande	Project superintendent, Bureau of Reolamation	El Paso, Tex.
Riverton	do	Riverton, Wyo.
Salt Lake Basin	Construction engineer	Coalville, Utah.
Salt River	General superintendent, Salt River Valley Water Users' Association.	Phoenix, Ariz.
Shoshone	Project superintendent, Bureau of Reclamation	Powell, Wyo.
Strawberry Valley	Manager, Strawberry Water Users' Association	Provo, Utah.
Sun River	Project superintendent, Bureau of Reclamation	Fairfield, Mont.
Umatilla—West	Manager, west extension irrigation district	Irrigon, Oreg.
Umatilla—East	Manager, Hermiston irrigation district	Hermiston, Oreg.
Uncompahgre	Project superintendent, Bureau of Reclamation	Montrose, Colo.
Vale	Construction engineer	Vale, Oreg.
Yakima	Project superintendent, Bureau of Reclamation	Yakima, Wash.
Yuma	do	Yuma, Ariz.

OPPORTUNITIES FOR SETTLERS

The use of interest-free capital.—In considering the purchase of farm lands on a reclamation project the fact that the repayment period to return the acre cost of water covers many years (20 years under the act of August 13,1914, not to exceed 40 years under the act of May 25, 1926, or on the basis of 5 per cent of the gross acre annual income, which plans have been previously explained herein) and that during the period of repayment there are no interest charges except against overdue payments, it must be realized that these conditions are of benefit to the farmer settling upon them.

Variety of climatic and soil conditions.—The projects, located in 15 of the 17 Western States, represent a great variety of climatic conditions, as, for example, Salt River, Ariz., and Lower Yellowstone, Mont. There are also great differences in elevation. Grand Valley, for example in Colorado, has an elevation of 4,700 feet, and Yuma, in Arizona, 110 feet. Likewise there is a great variation in soil conditions between the various projects, and even between farms on a project. These factors of soil and climate determine the kind of crops that can be profitably grown. These conditions vary so widely that the southern projects produce cotton, citrus fruits, and other semitropical plants, whereas on the more northern projects hardier crops, such as sugar beets, alfalfa, grains, apples, and potatoes, are the chief products.

Settler should choose.—Settlers should determine, if possible, the kind of agriculture they desire to follow and to which their experience and capital are best suited, as well as the climatic conditions most suitable to their well-being. The most satisfactory way to determine these things is to inspect the land before making a selection or purchase and spend enough time in a community to determine if the farm under consideration offers a satisfactory opportunity for the economic and social growth of the family. The employees of the Bureau of Reclamation may be relied upon to give courteous treatment and wholesome advice to intending settlers. Detailed information as to climate, crops, schools, churches, transportation, and towns is given for each project in the succeeding pages of this booklet.

Capital required.—The capital a settler should have to purchase either raw or developed land is difficult to state. There are many conditions which enter into the question. Much depends on the condition of the land when selected or purchased and the time and expense required to bring the farm into production. If the land is rough it will have to be leveled. Ditches may have to be constructed. The experience of the settler has something to do with it, as well as the number of workers in the family. Some settlers almost from the beginning grow a large portion of the food required for the table; others buy their food and do not make the highest use of milk, butter, poultry, eggs, vegetables, and field crops grown or that can be grown. As a general rule a settler should not attempt the undertaking with less than from $2,000 to $3,000, and more would be better.

The tabulation on the following page shows that the development of an irrigated farm requires an investment of from $7,000 to $10,000. In addition to this capital investment, operating and living expenses must be met. To start with the minimum requirement of $2,000 and dig the balance out of the soil is a slow process and means several years of hardship and privation. It is very essential that some means of credit be provided during the development period.

Cost of developing raw land.—In order that settlers may consider the cost of developing raw land, an example is given hereunder. This does not refer to a particular project, but is merely to suggest to settlers that a program of financing and development is needed beforehand which will assist them in the purchase and development of a farm:

Estimated expenditures for the first four years to convert 80 acres of raw land into a dairy and mixed farm

Item	First year	Second year	Third year	Fourth year
House, material only	$450		$100	
Barn, material only	100			$150
Sheds and outbuildings, material only	75	$150		
Chicken house, material only	50			
Pig house and pens, material only		50		
Cased well and pump	200			
Fences, corrals, etc., material only	400	50		
Silo				400
Clearing, leveling, etc., exclusive of own labor	300			
Four horses	300			
Harness, 2 sets, second hand	75			
Cows (1), calves second-year	100	25		
Replacement cows			300	100
Bull (one-half interest)			75	75
Sows (3) (1 pig first year)	5	80		
Boar (one-third interest)		20		20
Chickens	25	25		
Sheep (20 to 60)	250	500		
Automobile (used)	250			400
Walking plow	32			
Harrow, two sections, secondhand	15			
Mower, secondhand		35		
Rake, secondhand		15		
Wagon gears, secondhand	50			
Hayrack (material)	20			
Hay stacker, secondhand		40		
Separator and dairy utensils			120	5
Corrugator, materials	5			
Single cultivator	12			
Lumber (miscellaneous)		50	50	50
Small tools and canvas	50	25	10	10
Seed	275	15	15	40
Binder, secondhand	50	50		
OPERATING				
Harvesting	25	15		
Threshing	150	60	25	25
Labor, exchange with neighbors			100	100
Taxes			125	125
Insurance, fire			40	
Water (O. & M.)	95	95	95	95
Repairs and blacksmithing	10	15	20	25
Veterinary		15	25	25
Auto operation	150	150	150	150
PERSONAL				
Furniture	200		100	
Living expenses	600	400	400	400
Life insurance			60	60
Amusements, etc	50	50	50	50
Dentist and doctor	50	50	50	50
Total	4,419	1,980	1,910	2,355

NOTE.—A settler possessing some of the items given can offset them against the cash required. The prices of farm equipment are based on the cost of secondhand articles purchased at auction sales. If it is necessary to purchase new machinery the total investment will be largely increased.

Available farms.—The amount of public land available is continually changing, which makes it inadvisable to include such a list in this booklet. Lists are kept up to date in each project office and may be obtained upon request. Privately owned land and developed farms are available on all the projects and information may be obtained by writing to the project superintendent or manager.

HINTS TO SETTLERS

Farming is a business requiring skill, industry, and the use of capital intelligently directed to make it pay. The selection of a farm is an important step in the undertaking, to which careful consideration should be given. Hereunder is given a list of items which experience has shown should be considered by the settler before making a selection or purchase:

1. Ascertain from the project office:
   - (*a*) Amount of construction charge. Are any installments of such charge delinquent?
   - (*b*) Amount of supplemental construction charge. Are any installments of such charge delinquent?
   - (*c*) Amount of annual O. & M. charges. Are any such charges delinquent?
   - (*d*) Assessments made by water users' association or irrigation district. Are any such charges delinquent?
   - (*e*) Area of the farm classed as irrigable (charges are based on irrigable area).
   - (*f*) Are ditches and structures constructed to serve the farm with water?
   - (*g*) Has the land been soil surveyed? If it has, become familiar with map and soil types.
   - (*h*) Does the land need drainage? Has alkali developed?
   - (*i*) Is the land in a drainage or improvement district? Terms of repayment.
2. Inquire of county tax collector:
   - (*a*) Amount of State and county general taxes. Are such taxes delinquent?
   - (*b*) Amount of special assessment taxes and terms of payment for bond issues or contracts with United States. Are such taxes delinquent?
3. Inspect the farm in person and determine:
   - (*a*) Character of soil and depth.
   - (*b*) Area leveled for irrigation.
   - (*c*) Condition of farm ditches, buildings, and other improvements.
   - (*d*) Quality of domestic water.
   - (*e*) Drainage conditions and alkali.
   - (*f*) Character of crops and yields on adjacent farms.
   - (*g*) Distance to schools, churches, and trading towns; character of roads.

4. When these investigations have been made make out a financial and agricultural program allocating capital for the things needed, similar to the example given on page 12, and deduct from the total yearly expenditures a reasonable estimate for the value of crops that may be grown.
5. Whenever possible the land and surroundings should be inspected by the purchaser's wife, if he has one, as her judgment and opinions should be considered.
6. Inquire fully into status of title. (Sometimes the purchaser gets a deed and does not know for years after that title is in the United States. Project employees can advise purchaser how titles may be examined.)

METHODS OF APPLYING IRRIGATION WATER

The canal systems of Federal reclamation projects are constructed so that water is delivered to each farm and the farmer must take charge of it at his property line and distribute it over the land. The method to be followed depends principally upon the topography and slope of the ground, the character of the surface soil and subsoil, the kind of crop to be irrigated, and the quantity of water to be used. The inexperienced irrigator should secure the best advice available and whenever possible consult the project superintendent.

The five methods generally followed in applying irrigation water are briefly described and shown in the following illustrations:

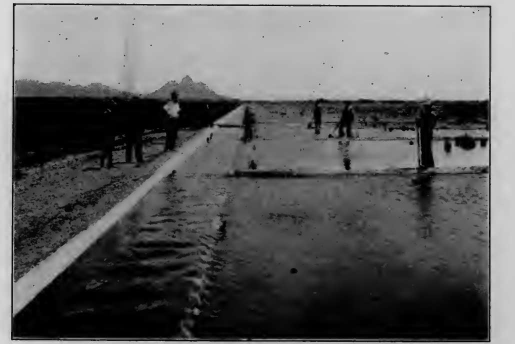
Flooding.—In irrigating by the flooding method field laterals are run out from the farm-head ditch at intervals of 75 to 100 feet apart, sometimes down the line of steepest slope but usually on a grade of 3 to 4½ inches in each 100 feet. These field laterals should be large enough to carry the head used, which may range from 1 to 3 or more cubic feet per second. By means of canvas dams placed at frequent intervals the water is turned out of the farm laterals and spread over the field. This method has one advantage in that the first cost is low, but it takes considerably more effort to handle the water and spread it evenly over the area to be irrigated.

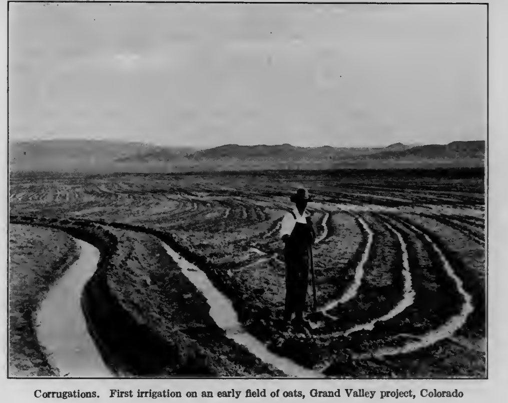
The border method.—The border method of irrigation in the west consists in the division of the field into a series of long narrow strips by means of low levees about 6 inches high and 5 or 6 feet wide, running down the line of steepest slope and spaced from 20 to 100 feet apart, depending upon the slope of the ground, soil texture, and kind of crop. The distance between head ditches must also be determined by local conditions. The border system is best adapted to land having a gentle slope where large heads of water can be used to advantage. The system must be well planned and constructed so that when the water is turned onto the land it will spread across the strip and flow down the slope in a uniform sheet. This method is best adapted to a developed farm that has been irrigated a few years by the flooding method where the irrigator has had an opportunity to see how the water can best be handled and how far a good-sized head can be forced over the land. This method is well adapted to the irrigation of an alfalfa field or permanent pasture, as the low levees can be cropped and farmed the same as the level portions of the field, and while there is considerable work involved in constructing permanent head ditches and levees there is a very material saving in the cost of handling the water. The border method is described in considerable detail in Farmers' Bulletin No. 1243.

Corrugations.—The corrugation method of irrigation, as illustrated, is accomplished by running small furrows, spaced from 16 to 48 inches apart, down the line of steepest slope, and turning into each furrow a small quantity of water and letting it run long enough to thoroughly wet the soil, partially by a capillary movement of the water. Ordinarily the corrugations are from 4 to 6 inches in depth and the distance between furrows should be such as to permit the water to thoroughly wet the top soil while it is saturating the maximum depth of plant growth. In general practice the interval between corrugations varies from 16 inches to 3 or 4 feet, with an average of about 2 feet. No hard-and-fast rule can be given as to the length of corrugations or distance between head ditches. That will depend on the slope of the ground and the character of the soil and the subsoil.

Flooding. Irrigating alfalfa, Salt River project, Arizona

On many of the Government projects the corrugation method is the principal method followed in irrigating grain and alfalfa or sweet-clover. It is about the only method that can be successfully followed where there is considerable slope to the land, and particularly in the


Border method. Irrigation from cement ditches, Salt River project, Arizona


Corrugations. First irrigation on an early field of oats, Grand Valley project, Colorado

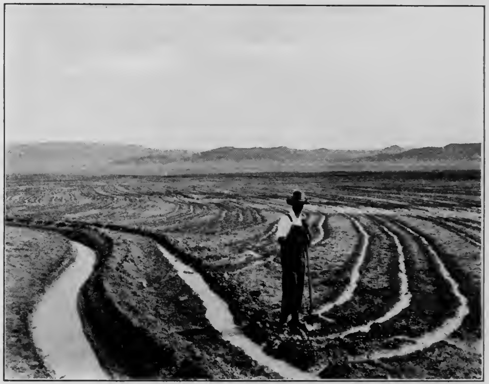
farm that has been irrigated a few years by the flooding method where the irrigator has had an opportunity to see how the water can best be handled and how far a good-sized head can be forced over the land. This method is well adapted to the irrigation of an alfalfa field or permanent pasture, as the low levees can be cropped and farmed the same as the level portions of the field, and while there is considerable work involved in constructing permanent head ditches and levees there is a very material saving in the cost of handling the water. The border method is described in considerable detail in Farmers' Bulletin No. 1243.

Corrugations.—The corrugation method of irrigation, as illustrated, is accomplished by running small furrows, spaced from 16 to 48 inches apart, down the line of steepest slope, and turning into each furrow a small quantity of water and letting it run long enough to thoroughly wet the soil, partially by a capillary movement of the water. Ordinarily the corrugations are from 4 to 6 inches in depth and the distance between furrows should be such as to permit the water to thoroughly wet the top soil while it is saturating the maximum depth of plant growth. In general practice the interval between corrugations varies from 16 inches to 3 or 4 feet, with an average of about 2 feet. No hard-and-fast rule can be given as to the length of corrugations or distance between head ditches. That will depend on the slope of the ground and the character of the soil and the subsoil.

Flooding. Irrigating alfalfa, Salt River project, Arizona

On many of the Government projects the corrugation method is the principal method followed in irrigating grain and alfalfa or sweet-clover. It is about the only method that can be successfully followed where there is considerable slope to the land, and particularly in the

Border method. Irrigation from cement ditches, Salt River project, Arizona



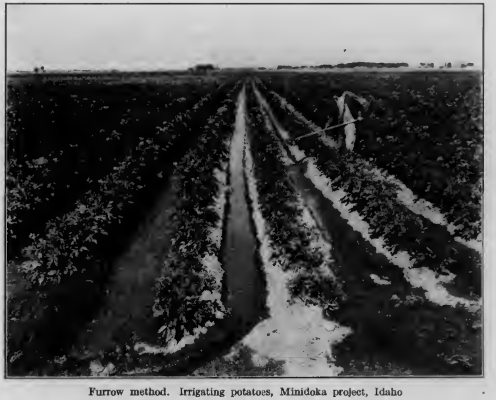
Corrugations. First irrigation on an early field of oats, Grand Valley project, Colorado case of raw land being cropped and irrigated for the first time. Farmers' Bulletin No. 1348 describes very fully the corrugation method and the various kinds of tools used in preparing the ground.

The furrow method of irrigation, as indicated, consists of small furrows starting at the head ditch and running down the slope for a distance that may range from 300 to 1,200 feet, depending upon soil texture, character of subsoil, and slope of the ground. This method is followed with all row crops, such as sugar beets, potatoes, beans, peas, corn, etc., as well as orchards and small fruits. Here, again, experience is the best guide to follow in laying out a furrow system. Each furrow is a small irrigation ditch, and if the water has too great a velocity it will scour and cause damage to land and crops. Ordinarily where the slope is from 4 to 6 inches in 100 feet, furrows can follow the line of steepest slope, but where the slope exceeds 2 feet in 100 the furrows should follow a grade contour so that the water will move at a velocity that will not cause erosion and give it a chance to wet the soil occupied by the root system.

Basin and dike method.—This method of irrigating arid land is best adapted to very flat lands where it is possible to inclose a field with a low dike just high enough to retain the depth of water required for irrigation. Water is turned in at the upper side of the plat and the field is flooded. After the water has stood a sufficient length of time to penetrate into the subsoil it is then turned into a lower plat and so on until the entire area has been irrigated. The length of the tract inclosed by a dike will vary with the slope of the ground, and the width will be governed to a considerable extent by the size of the irrigating head used. This method of handling water calls for a relatively large first cost and must be carefully laid out, but when once installed the ground can be easily and cheaply irrigated.

No attempt has been made to cover in detail the five methods ordinarily used nor to describe the farm equipment required in constructing the several systems. Bulletins have been issued by the Department of Agriculture covering the several methods in considerable length, and if further information is desired copies of the following Farmers' Bulletins should be secured through the county agent, State extension service, or from the Department of Agriculture at Washington, D. C.:

Farmers' Bulletin No. 392.	Irrigation of Sugar Beets.
Farmers' Bulletin No. 863.	Irrigation of Grain.
Farmers' Bulletin No. 864.	Practical Information for Beginners in Irrigation.
Farmers' Bulletin No. 865.	Irrigation of Alfalfa.
Farmers' Bulletin No. 1243.	The Border Method of Irrigation.
Farmers' Bulletin No. 1348.	The Corrugation Method of Irrigation.
Farmers' Bulletin No. 1518.	Orchard Irrigation.



Furrow method. Irrigating potatoes, Minidoka project, Idaho

Basin and dike method. Border irrigation, preparing raw land, Klamath project, Oregon-California case of raw land being cropped and irrigated for the first time. Farmers' Bulletin No. 1348 describes very fully the corrugation method and the various kinds of tools used in preparing the ground.

The furrow method of irrigation, as indicated, consists of small furrows starting at the head ditch and running down the slope for a distance that may range from 300 to 1,200 feet, depending upon soil texture, character of subsoil, and slope of the ground. This method is followed with all row crops, such as sugar beets, potatoes, beans, peas, corn, etc., as well as orchards and small fruits. Here, again, experience is the best guide to follow in laying out a furrow system. Each furrow is a small irrigation ditch, and if the water has too great a velocity it will scour and cause damage to land and crops. Ordinarily where the slope is from 4 to 6 inches in 100 feet, furrows can follow the line of steepest slope, but where the slope exceeds 2 feet in 100 the furrows should follow a grade contour so that the water will move at a velocity that will not cause erosion and give it a chance to wet the soil occupied by the root system.

Basin and dike method.—This method of irrigating arid land is best adapted to very flat lands where it is possible to inclose a field with a low dike just high enough to retain the depth of water required for irrigation. Water is turned in at the upper side of the plat and the field is flooded. After the water has stood a sufficient length of time to penetrate into the subsoil it is then turned into a lower plat and so on until the entire area has been irrigated. The length of the tract inclosed by a dike will vary with the slope of the ground, and the width will be governed to a considerable extent by the size of the irrigating head used. This method of handling water calls for a relatively large first cost and must be carefully laid out, but when once installed the ground can be easily and cheaply irrigated.

No attempt has been made to cover in detail the five methods ordinarily used nor to describe the farm equipment required in constructing the several systems. Bulletins have been issued by the Department of Agriculture covering the several methods in considerable length, and if further information is desired copies of the following Farmers' Bulletins should be secured through the county agent, State extension service, or from the Department of Agriculture at Washington, D. C.:

Farmers' Bulletin No. 392.	Irrigation of Sugar Beets.
Farmers' Bulletin No. 863.	Irrigation of Grain.
Farmers' Bulletin No. 864.	Practical Information for Beginners in Irrigation.
Farmers' Bulletin No. 865.	Irrigation of Alfalfa.
Farmers' Bulletin No. 1243.	The Border Method of Irrigation.
Farmers' Bulletin No. 1348.	The Corrugation Method of Irrigation.
Farmers' Bulletin No. 1518.	Orchard Irrigation.

Furrow method. Irrigating potatoes, Minidoka project, Idaho

Basin and dike method. Border irrigation, preparing raw land, Klamath project, Oregon-California

ARIZONA, SALT RIVER PROJECT

THE Salt River project is located in the south-central part of Arizona on both sides of Salt River, in the vicinity of Phoenix. The climate is semitropical and ranges in temperature from 20° to 117° F. A considerable area of the project on the higher lands farthest from the river and near the adjacent mountains, is, owing to superior air drainage, practically free from killing frosts, and is, therefore, especially well adapted to the economical production of citrus fruits. The average annual precipitation is 8.34 inches. The elevation of the project averages about 1,200 feet above sea level.

The project owes its outstanding success to the assured water supply made available by the construction of Roosevelt storage dam and Granite Reef diversion dam, both of which structures were built by the Bureau of Reclamation, 1906–1911. Later development by the Salt River Valley Water Users' Association, which has operated the project since November, 1917, includes the construction of three large dams and power plants on the Salt River between Roosevelt and Granite Reef, at Horse Mesa, Mormon Flat, and Stewart Mountain. These dams, with Roosevelt, create a continuous chain of lakes nearly 60 miles long. Other major items of project development by the association include 180 drainage and irrigation pumps, varying from one-half second-foot to 15 second-feet capacity, a $600,000 multiple arch flood-control dam on Cave Creek, the lining of 30 miles of main canals, and a power distribution system serving electricity to every farm on the project.

The water supply is furnished by the uncontrolled flow of the Verde River and the flow of the Salt River, controlled by the 2,000,000 acre-feet storage of the four dams above Granite Reef. The project irrigates 250,000 acres of land, including irrigated town-site areas, and also furnishes a complete or partial supply to 88,000 acres of adjacent nonproject land. All project land is under private ownership and highly developed. An important factor in the success of the project is the power system. The association has eight hydroelectric plants, one at each of the four storage dams on the Salt River and four located on the canal system in the valley, the total generating capacity of the system being 100,000 horsepower.

Owing to the warm winters, the project has a 12 months' growing season and frequently two different crops are grown during a season. The area devoted to citrus fruits, head lettuce, and winter vegetables is increasing rapidly. The leading crops, in point of area, are cotton and alfalfa. Grain, which makes a good winter growth and furnishes excellent winter pasture, is third from an acreage standpoint. The project has a large summer acreage in cantaloupes and devotes some area to dates, grapes, and figs. Deciduous fruits are very little grown. Corn, hegari, and the various sorghums are grown for feed and ensilage. The other principal grains are barley and wheat. In 1929 the project had approximately 25,000 dairy cattle. Conditions are exceptionally favorable for a large expansion of this industry. Excellent winter pasture supports large numbers of cattle and sheep brought in from the ranges nearby and elsewhere in the State. Cottonseed meal, hulls, and other by-products of the cotton industry are among the feeds used in fattening stock. Very few hogs are raised, their production usually being a side issue to general farming. Natural conditions are ideal for poultry raising, but this industry is considerably underdeveloped. The valley farmers have strong cooperative organizations for the marketing of cotton, hay, and grain, lettuce, vegetables, and citrus. The project is well supplied with meat-packing houses, flour mills, creameries and milk canneries, numerous cotton gins, and vegetable and fruit packing houses.

There are eight towns and cities within the project limits, the largest being Phoenix, with a population in 1929 estimated at 48,000, that of the other towns combined being approximately 20,000. The farm population in 1929 was estimated at 55,000. There are 68 churches, 69 schools, and 15 banks. There are over 400 miles of paved roads in the project outside of cities and towns, a very small percentage of farms being more than a mile from paving.

The near-by lakes and fine roads afford unusual recreational facilities, and the valley has a large and growing winter tourist population with many maintaining winter homes. The excellent highway system maintained by the county and State makes the high pine-covered mountain country, north and east, accessible in summer in an easy three or four hour drive. Many valley residents maintain summer homes or cabins in these locations, making the week-end trip by automobile.

Phoenix is on the main line of the Southern Pacific Railroad, and it is also served by the Santa Fe system. These facilities, with the fast truck freight service maintained between Phoenix and Los Angeles, afford ample transportation facilities which are of great value in marketing different farm commodities. Phoenix has four airports, including one maintained by the municipality, and regular passenger lines are operated between El Paso, Phoenix, and Los Angeles.

ARIZONA-CALIFORNIA, YUMA PROJECT

THE Yuma project is located in the southern part of Yuma County, Ariz., and the southeastern part of Imperial County, Calif., on both sides of the Colorado River, adjacent to Mexico. The climate on this project is subtropical, with a range from 20° to 117° F. in the valley lands and from 29° to 117° F. on the mesa lands. Few places have as much sunshine, and the mild, dry winters are unsurpassed anywhere in the United States. Light frosts on the valley lands usually occur from November to March, while on the mesa lands, which are devoted principally to the growing of citrus fruit, damaging frosts have not been experienced in the past 35 years. The average annual precipitation is 3.1 inches. The elevation of the irrigable lands in the valley varies from 80 to 140 feet above sea level; the mesa lands are some 75 feet higher in elevation.

The project is well served with engineering structures and a well-designed canal and lateral system to convey water from the Colorado River to the project lands. The main engineering features are the Laguna diversion dam, of the Indian weir type, which is built across the Colorado River some 13 miles northeast of Yuma; the Colorado River Siphon, which carries the irrigation water from the California side of the river to the Arizona side; and the Siphon Drop power plant, constructed in 1926, which supplies all the necessary power for project pumping plants and machine shops and provides an annual revenue to the water users through the commercial sale of all surplus energy. The Colorado River is a silt-bearing stream, but a desilting basin at the intake works removes the heavier portion of the silt burden. The supply of irrigation water is always adequate, and water for domestic purposes is obtained from wells.

The gravity portion, or the Yuma project proper, comprises about 65,000 acres of bottom lands, some 14,000 acres of which lie on the California side and the remainder on the Arizona side of the river. About 8,000 acres of the California tract have been allotted to the Yuma Indians. The lands of both valley and mesa are generally flat, but require leveling before water may be applied to them. The soils of the valley or bottom lands are alluvial in character and very fertile. These range from a light sandy loam to adobe, with varying mixtures of both; while the mesa lands are sandy and require green or stable manure to build up their fertility.

The mesa lands include 45,000 acres in Arizona. Works have been constructed for the irrigation of 4,000 acres in unit "B," water being supplied by pumping from the project gravity system. The developed area in this division has practically all been planted to citrus, for which it is very well adapted, as climatic conditions are especially favorable, with long hot growing seasons and no damaging frosts. On the valley lands, for which water is supplied by gravity from the Colorado River diverted at Laguna Dam, the long growing season also favors the growth of a large variety of crops, which include cotton, alfalfa, alfalfa seed, winter vegetables, lettuce, melons, and small grains. Cotton, alfalfa, and alfalfa seed are the major crops. Cotton yields average 1 bale per acre, alfalfa from 4 to 7 tons per acre, and alfalfa seed from 200 to 500 pounds per acre, depending on the soil and methods of farming. Climatic and soil conditions are espe-

ORCHARDS

1. ALMONDS
   ORLAND PROJECT, CALIFORNIA
2. SPRAYING APPLES
   YAKIMA PROJECT, WASHINGTON
3. ENGLISH WALNUTS
   ORLAND PROJECT CALIFORNIA
4. GRAPE FRUIT
   YUMA PROJECT, ARIZONA
5. PEACHES
   GRAND VALLEY PROJECT, COLORADO
6. DATE PALMS
   SALT RIVER PROJECT ARIZONA

passed anywhere in the United States. Light frosts on the valley lands usually occur from November to March, while on the mesa lands, which are devoted principally to the growing of citrus fruit, damaging frosts have not been experienced in the past 35 years. The average annual precipitation is 3.1 inches. The elevation of the irrigable lands in the valley varies from 80 to 140 feet above sea level; the mesa lands are some 75 feet higher in elevation.

The project is well served with engineering structures and a well-designed canal and lateral system to convey water from the Colorado River to the project lands. The main engineering features are the Laguna diversion dam, of the Indian weir type, which is built across the Colorado River some 13 miles northeast of Yuma; the Colorado River Siphon, which carries the irrigation water from the California side of the river to the Arizona side; and the Siphon Drop power plant, constructed in 1926, which supplies all the necessary power for project pumping plants and machine shops and provides an annual revenue to the water users through the commercial sale of all surplus energy. The Colorado River is a silt-bearing stream, but a desilting basin at the intake works removes the heavier portion of the silt burden. The supply of irrigation water is always adequate, and water for domestic purposes is obtained from wells.

The gravity portion, or the Yuma project proper, comprises about 65,000 acres of bottom lands, some 14,000 acres of which lie on the California side and the remainder on the Arizona side of the river. About 8,000 acres of the California tract have been allotted to the Yuma Indians. The lands of both valley and mesa are generally flat, but require leveling before water may be applied to them. The soils of the valley or bottom lands are alluvial in character and very fertile. These range from a light sandy loam to adobe, with varying mixtures of both; while the mesa lands are sandy and require green or stable manure to build up their fertility.

The mesa lands include 45,000 acres in Arizona. Works have been constructed for the irrigation of 4,000 acres in unit "B," water being supplied by pumping from the project gravity system. The developed area in this division has practically all been planted to citrus, for which it is very well adapted, as climatic conditions are especially favorable, with long hot growing seasons and no damaging frosts. On the valley lands, for which water is supplied by gravity from the Colorado River diverted at Laguna Dam, the long growing season also favors the growth of a large variety of crops, which include cotton, alfalfa, alfalfa seed, winter vegetables, lettuce, melons, and small grains. Cotton, alfalfa, and alfalfa seed are the major crops. Cotton yields average 1 bale per acre, alfalfa from 4 to 7 tons per acre, and alfalfa seed from 200 to 500 pounds per acre, depending on the soil and methods of farming. Climatic and soil conditions are espe-

---

ORCHARDS

1. ALMONDS
ORLAND PROJECT, CALIFORNIA
2. SPRAYING APPLES
YAKIMA PROJECT, WASHINGTON
3. ENGLISH WALNUTS
ORLAND PROJECT CALIFORNIA
4. GRAPE FRUIT
YUMA PROJECT, ARIZONA
5. PEACHES
GRAND VALLEY PROJECT, COLORADO
6. DATE PALMS
SALT RIVER PROJECT ARIZONA

cially favorable to the growing of winter vegetables, lettuce, and melons. The areas devoted to these crops have increased during the past few years. It has been demonstrated beyond the experimental stage that the soil and climate are well adapted for the growing of paper-shell pecans, and the successful development of this crop indicates that the pecan will advance into one of the major crops of the project. Dairying, which is a very important branch of irrigation farming, has not kept pace with other improvements on this project, and a splendid opportunity exists to those desiring to enter into this industry. Sheep and cattle feeding during the winter months has been found profitable, and the project's proximity to the Pacific coast cities insures a favorable market for all stock.

Cotton gins and vegetable and fruit packing houses are located on the project at convenient points. Cooperative associations handle the ginning of a major portion of the cotton crop, as well as the marketing of alfalfa and alfalfa seed.

The main line of the Southern Pacific system from New Orleans to Los Angeles and San Diego crosses the project at Yuma and gives quick service to the Pacific coast cities, the Gulf of Mexico, and eastern markets. The project is traversed by some 55 miles of paved highways, placing each farm within at least 1½ miles of a pavement. The Broadway of America passes through Yuma and furnishes an outlet to the Pacific coast over an almost continuous pavement.

The towns of the project are Yuma, Somerton, and Gadsden in Arizona, and Bard in California. Yuma is the principal business center and has a population of approximately 5,000. The population of the other project towns and farms amounts to approximately 5,500. The project is well provided with educational facilities, there being a union high school, which furnishes free transportation to students, and a well equipped and modern set of consolidated grade schools. Most of the principal religious denominations have organizations in Yuma and the smaller project towns. Fraternal and civic organizations are well represented in Yuma, and social activities are amply provided for. Wild game and birds abound in the surrounding country. During the summer months recreation is taken at the beaches along the Pacific Ocean in the vicinity of San Diego or Los Angeles and at the mountain resorts in northern Arizona.

CALIFORNIA, ORLAND PROJECT

THE Orland project is located in the north-central portion of the Sacramento Valley, 100 miles north of Sacramento, the State capital, and 166 miles north of San Francisco. The climate is semitropical. The mean annual temperature at Orland for a period of 45 years is 63.7° F. and the range is from 19° to 116° F. Damaging

frosts seldom occur. The average rainfall is 17.9 inches, most of which occurs during the winter season. The elevation of the irrigated lands varies from 180 to 330 feet above sea level.

The engineering features include East Park Dam and Reservoir on Little Stony Creek; a feed canal 7 miles in length running from Stony Creek to the reservoir; Stony Gorge Dam and Reservoir on Stony Creek, 18 miles below East Park; three diversion dams; and 146 miles of canals and laterals, 92 of which are concrete lined, together with 2,000 irrigation structures, also of concrete construction. Water is diverted from Stony Creek through the feed canal for storage in East Park Reservoir, which has a capacity of 51,000 acre-feet. The capacity of Stony Gorge Reservoir is 50,200 acre-feet. The water supply is not only adequate in normal years to produce full crops but is also sufficient to provide hold-over storage for a possible succeeding year of drouth and consequent deficient run-off, and thus protect the project from crop damage and failure even in extremely dry seasons.

The irrigable area of the project is 20,800 acres, and of this 15,500 acres have been irrigated. The lands are generally level, with a slope of about 15 feet to the mile toward the Sacramento River. Water is supplied to the land for the irrigation of forage crops, principal of which is alfalfa, by the border, or flood system; furrow irrigation is used for orchards and milo. Both underground and surface drainage are excellent, so that after 20 years' operation of the project no drainage problems due to rising of ground water levels have developed, and no drainage construction works have been found necessary. The soil consists of alluvial deposits from Stony Creek, with an admixture of wash from adjacent more elevated areas. The varieties are gravelly loam, clay, and sediment loam, all deep and very productive. There is no hardpan nor alkali.

A great variety of products, many of them subtropical in nature, are grown, including alfalfa, milo maize, barley, almonds, oranges, English walnuts, prunes, figs, peaches, apricots, pears, lemons, grapefruit, grapes (both table and raisin), olives, watermelons, casabas, and many varieties of berries. Alfalfa predominates in acreage, but nuts and fruits are also grown on a commercial scale. Orland oranges are noted for their flavor, color, and early maturing, and because of these features they command high prices for the holiday trade. Alfalfa yields from 4 to 7½ tons per acre per year, with five cuttings, and yields of other crops are generally high because of the long growing season. Dairying is an important and profitable business, owing to the mild climate, good markets, and feed conditions. Poultry raising, especially that of turkeys, is an important industry. The hills and mountains west of the project are used extensively for the grazing of sheep and cattle.

Local industries comprise two creameries (producing over one and one-third million pounds of butter annually), a packing house for oranges, olives, and almonds, a fig cannery and several cooperative marketing organizations. The Southern Pacific Railway and the concrete-paved Pacific State highway pass through the project and connect it with San Francisco and Portland. Orland, having a population of 1,200, is the principal town. The farm population is about 2,000. There are nine grade schools and one high school within the boundaries of the project. There are many church, fraternal, and other social organizations. The Farm Bureau and Grange provide social and educational advantages. For the boys and girls there are the Camp Fire and Boy Scout organizations. In the Coast Range Mountains, within a few hours' auto drive from Orland over good roads, are found deer, bears, mountain lions, and trout; and in the valley and foothill regions adjacent to the project are quail, doves, wild ducks, and geese.

COLORADO RIVER, BOULDER CANYON PROJECT

ON DECEMBER 21, 1928, the President approved the Boulder Canyon project act, which authorizes the construction by the Secretary of the Interior of the Boulder Dam and incidental works on the Colorado River at a cost not to exceed $165,000,000. The project includes:

(*a*) The construction of the Boulder Dam in Black Canyon where the Colorado River forms the boundary between the States of Arizona and Nevada. This construction will raise the present water surface of the river 582 feet. The dam site is about 30 miles southeast of Las Vegas, Nev., located on the Los Angeles and Salt Lake line of the Union Pacific system. The dam will be over 700 feet in height, the highest ever constructed, and will create a reservoir with a capacity of 30,500,000 acre-feet. It will serve to impound the surplus flood waters of the Colorado River for use in irrigation and will also protect the lands in the valleys adjacent to the river below the dam and in the Imperial Valley in California from overflow, water shortage, and silt accumulation, which are at present a great menace to successful agriculture. The lake formed by the dam will be about 115 miles in length and have an area of 145,000 acres—the largest artificial reservoir in the world.

(*b*) The development of about 1,200,000 horsepower hydroelectric energy at the dam, with 12 units of 100,000 horsepower each, which will make 663,000 firm or constant horsepower available at all times.

(*c*) The construction of an all-American canal from Laguna Dam on the Yuma project, Arizona-California or other suitable diversion dam, to connect with the present irrigation distribution system in the Imperial Valley in southern California, a distance of about 75 miles, and an extension to the adjacent Coachella Valley.

It is expected that it will take ten or more years to complete the dam from the time construction is begun.

All public lands in the immediate vicinity of the dam and reservoir sites have been withdrawn from entry for construction purposes. All public lands which will be irrigated under the Boulder Canyon project have been withdrawn from entry and will not be available for settlement until the dam is completed and water can be furnished for irrigation purposes. The lands, when restored, are to be subject to entry under the reclamation law, and preference right of entry is to be given to ex-service men. It will be a number of years before irrigation water will be available and the land to be irrigated opened to settlement and development. There are no irrigable lands in the immediate vicinity of the reservoir, such lands as are susceptible of irrigation under this project being mainly in the vicinity of Parker, Ariz., in the areas tributary to the Yuma project in Arizona, the Palo Verde or Blythe project, California, and lands in the Imperial and Coachella Valleys of California.

The principal crops to be grown on the land susceptible of irrigation will probably be similar to those now grown in southwestern United States, such as cotton, alfalfa, winter vegetables, lettuce, small grains, pecans, and citrus and deciduous fruits.

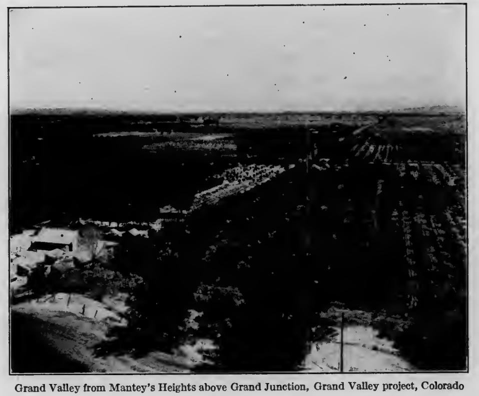
COLORADO, GRAND VALLEY PROJECT

THE Grand Valley project is in the western part of Colorado, near the town of Grand Junction, and runs along the north side of the Grand Valley for about 40 miles. The average elevation is 4,700 feet above sea level. The climate is mild, wind movement is moderate, and the seasons are usually long, 182 days being the average time between killing frosts. Precipitation is about 8 inches and the number of clear days averages 254 per year.

A roller-crest dam diverts water from the Colorado River into a canal which extends westward along the north side of the Grand Valley for about 55 miles. The canal, with a capacity of 1,425 second-feet at its head, and its distributing laterals deliver water to each farm unit. Stored water is not needed because of the abundant supply in the river. Water for domestic and stock purposes is taken from the canal and stored in cisterns, tanks, or reservoirs. Private and district irrigation systems furnish water to 46,000 acres of land which is nearly all farmed. Under the project gravity system water is available for 30,400 acres, and in addition it is planned to irrigate 8,500 acres by pumping. Water is also furnished for 10,000 acres of private land in the Orchard Mesa district.

The district is quite rolling, with considerable fall toward the river. Numerous arroyos or washes furnish outlets for drainage and storm water. The soils consist of three general types—red sandy mesas, sandy loam, and adobe. The red soils are deep and well drained and are especially adapted for the growing of fruit, alfalfa, and potatoes, although other crops do well on them. The sandy loam is an alluvial deposit composed of a mixture of mesa soil and adobe. These soils are well adapted to general farm crops, but are not considered as valuable for fruit growing as the mesa type. Adobe soils are of a heavier nature and are especially adapted to alfalfa, sugar beets, and cereals.

The principal crops are alfalfa, sugar beets, beans, corn, oats, potatoes and wheat. Apples and other North Temperate Zone fruits are grown on the project, and string beans and tomatoes are also profitably grown. The best lands on the project will produce 5 tons of alfalfa per acre when well farmed, and other crops proportionately. The average yield of alfalfa is, however, approximately 3 tons per acre. Favorable climate, cheap winter forage, proximity to good range, and freedom from diseases make livestock raising attractive. A number of farmers are engaged in feeding range cattle during the winter months. This practice utilizes surplus feed. Dairying is developing rapidly. The territory surrounding the Grand Valley project comprises high plateaus and mountain ranges that furnish summer pasture for a great many cattle and sheep.



Grand Valley from Mantey's Heights above Grand Junction, Grand Valley project, Colorado

At Grand Junction are located a creamery, two flour mills, two canning factories, a sugar factory, and a packing house, which provide a market for much of the produce raised on the project. The project is on the main line of the Denver and Rio Grande Western Railroad. An interurban electric line operates between Grand Junction and Fruita, with an extension to serve project lands. None of the farms is more than 6 miles from a railroad shipping point. United States highways Nos. 40 south and 50 extend through the valley east to west. Surrounding mountain and mining towns and local valley towns furnish a good market for some of the products, and fruits is shipped to Denver and eastern markets.

Grand Junction, at the eastern end of the project, has a population of 10,459 and is the county seat of Mesa County. It has a daily newspaper, two banks, many factories and plants, and is also a distributing center for the large packing and wholesale houses, which maintain branch houses at this point. Other towns are Fruita, Loma, and Mack. There are 4 rural schools on the project. High schools are located at Grand Junction and Fruita. All of the towns serving the project have churches. Grand Mesa, 10,000 feet in elevation, is within a day's drive of the project. This flat-topped mountain has on it more than 200 lakes, stocked with trout. The mountains and canyons are picturesque and afford abundant recreation.

COLORADO, UNCOMPAHGRE PROJECT

THE Uncompahgre project is located in western Colorado, in Montrose and Delta Counties, along the Uncompahgre River. The climatic conditions are healthful and agreeable throughout the year. The average annual precipitation is 10 inches. The usual annual temperature ranges from a maximum of 96° F. to a minimum of −10° F. The number of clear days in the year varies from 225 to 274. The elevation of the irrigable lands ranges from 4,900 to 6,400 feet above sea level.

The Gunnison Tunnel is 6 miles in length and conducts water from the Gunnison River to the Uncompahgre River. Other engineering features are the canal system, the diversion dam on the Gunnison River, and a number of diversion structures on the Uncompahgre River. The water supply is obtained from the natural flow of the Uncompahgre River, supplemented by water from the Gunnison River. The irrigation waters are distributed to the irrigable lands by means of 8 large canal systems from the Uncompahgre River, together with numerous small laterals. About 550 miles of canals and laterals have been constructed. Domestic water is obtained from deep wells.

The district is quite rolling, with considerable fall toward the river. Numerous arroyos or washes furnish outlets for drainage and storm water. The soils consist of three general types—red sandy mesas, sandy loam, and adobe. The red soils are deep and well drained and are especially adapted for the growing of fruit, alfalfa, and potatoes, although other crops do well on them. The sandy loam is an alluvial deposit composed of a mixture of mesa soil and adobe. These soils are well adapted to general farm crops, but are not considered as valuable for fruit growing as the mesa type. Adobe soils are of a heavier nature and are especially adapted to alfalfa, sugar beets, and cereals.

The principal crops are alfalfa, sugar beets, beans, corn, oats, potatoes and wheat. Apples and other North Temperate Zone fruits are grown on the project, and string beans and tomatoes are also profitably grown. The best lands on the project will produce 5 tons of alfalfa per acre when well farmed, and other crops proportionately. The average yield of alfalfa is, however, approximately 3 tons per acre. Favorable climate, cheap winter forage, proximity to good range, and freedom from diseases make livestock raising attractive. A number of farmers are engaged in feeding range cattle during the winter months. This practice utilizes surplus feed. Dairying is developing rapidly. The territory surrounding the Grand Valley project comprises high plateaus and mountain ranges that furnish summer pasture for a great many cattle and sheep.

Grand Valley from Mantey's Heights above Grand Junction, Grand Valley project, Colorado

At Grand Junction are located a creamery, two flour mills, two canning factories, a sugar factory, and a packing house, which provide a market for much of the produce raised on the project. The project is on the main line of the Denver and Rio Grande Western Railroad. An interurban electric line operates between Grand Junction and Fruita, with an extension to serve project lands. None of the farms is more than 6 miles from a railroad shipping point. United States highways Nos. 40 south and 50 extend through the valley east to west. Surrounding mountain and mining towns and local valley towns furnish a good market for some of the products, and fruits is shipped to Denver and eastern markets.

Grand Junction, at the eastern end of the project, has a population of 10,459 and is the county seat of Mesa County. It has a daily newspaper, two banks, many factories and plants, and is also a distributing center for the large packing and wholesale houses, which maintain branch houses at this point. Other towns are Fruita, Loma, and Mack. There are 4 rural schools on the project. High schools are located at Grand Junction and Fruita. All of the towns serving the project have churches. Grand Mesa, 10,000 feet in elevation, is within a day's drive of the project. This flat-topped mountain has on it more than 200 lakes, stocked with trout. The mountains and canyons are picturesque and afford abundant recreation.

COLORADO, UNCOMPAHGRE PROJECT

THE Uncompahgre project is located in western Colorado, in Montrose and Delta Counties, along the Uncompahgre River. The climatic conditions are healthful and agreeable throughout the year. The average annual precipitation is 10 inches. The usual annual temperature ranges from a maximum of 96° F. to a minimum of $-10°$ F. The number of clear days in the year varies from 225 to 274. The elevation of the irrigable lands ranges from 4,900 to 6,400 feet above sea level.

The Gunnison Tunnel is 6 miles in length and conducts water from the Gunnison River to the Uncompahgre River. Other engineering features are the canal system, the diversion dam on the Gunnison River, and a number of diversion structures on the Uncompahgre River. The water supply is obtained from the natural flow of the Uncompahgre River, supplemented by water from the Gunnison River. The irrigation waters are distributed to the irrigable lands by means of 8 large canal systems from the Uncompahgre River, together with numerous small laterals. About 550 miles of canals and laterals have been constructed. Domestic water is obtained from deep wells.

The irrigation works are designed to irrigate approximately 105,000 acres of land. The country is rolling, with considerable slope to the north and west. The irrigable area comprises a number of benches and flats with abrupt declivities separting them. Some smoothing and floating is required before irrigating the land. The soils consist of red sandy, gravelly, and adobe and clay loams. The adobe and clay soils are located mainly on the east side of the Uncompahgre River and are suitable for raising alfalfa, grains, and sugar beets. The river bottom soils are peculiarly adapted to onions, sugar beets, and garden products. The red sandy and gravelly soils on the west side of the river are generally suited to all crops, but are usually devoted to high-priced crops, such as fruits, potatoes, and onions.

The principal crops grown are alfalfa, wheat, potatoes, onions, oats, corn, barley, apples, and sugar beets. Alfalfa yields from 2 to 5 tons per acre; wheat, oats, corn and barley, approximately 30 bushels; potatoes, from 175 to 250 bushels; onions, from 300 to 450 bushels; and sugar beets from 8 to 16 tons per acre. The furrow system of irrigation is used exclusively in this valley. Stock raising is one of the principal industries on the project. Dairying is an important industry and is increasing. Poultry farming is becoming an important industry. Concentrated products, such as butterfat, cheese, and sugar, are safe lines of production because of long distances to markets and consequent high transportation charges. The Uncompahgre Valley is bordered on nearly all sides by table-lands that afford summer range for cattle and sheep. There are also within a short distance of the project large areas of forests that are controlled by the United States Forest Service and leased on favorable terms to stockmen.

The project is served industrially by 3 flour mills, 1 radium sampler, 3 creameries, 2 brick and tile plants, 3 elevators, 1 canning factory, 2 cheese factories, 1 sugar factory, and 1 artificial ice plant. Both Montrose and Delta Counties have farm bureaus and employ county agents. The projects offers opportunity for canning factories, cheese plants, box mills, alfalfa mills, and other industries which could utilize the many products grown. The Denver & Rio Grande Western Railroad bisects the project, and good roads extend throughout the project and to neighboring towns over which auto freight lines are operated. The Pike's Peak Ocean to Ocean Highway, a part of the transcontinental highway system of the country, passes through the project. Livestock is marketed at Denver, Omaha, and Kansas City. Sugar beets are sent to the factory at Delta, and potatoes, onions, and fruit are shipped to Denver and eastern points. Local mining camps offer a market for vegetables and garden products, and alfalfa is fed to stock or disposed of locally to stockmen.

Montrose, the county seat of Montrose County, has a population of 3,502. Other project towns are Delta and Olathe, having populations of 2,700 and 750, respectively. These towns have chambers of commerce and luncheon clubs and are progressive. The farm population in 1929 was 5,750. Twenty-seven schools serve the project, 19 of which are in the rural districts. Accredited high schools are located in the 3 towns above mentioned. The principal religious denominations are represented and have churches in the towns of the project. The Uncompahgre Valley is located in one of the most picturesque sections of America. The San Juan Mountains are within a 2 hours' drive from Montrose. Excellent trout fishing and hunting are found in the mountains near by. The Gunnison River is noted for its scenery and fishing.

Harvesting barley on a farm near Nampa, Boise project, Idaho

IDAHO, BOISE PROJECT

THE Boise project is located in southwestern Idaho and eastern Oregon adjacent to the city of Boise. The general elevation of the project is 2,500 feet above sea level. The temperature rarely goes below zero or above 100°. The winters are generally mild and free from wind. The summers are long, sunshiny, and warm, and, with irrigation, plant growth is rapid. The precipitation at Boise for the past 65 years has averaged 13.4 inches per year.

On the Arrowrock division the principal engineering feature is Arrowrock Dam and Reservoir, which is located on the Boise River about 22 miles in a northeasterly direction from Boise, Idaho, and

The irrigation works are designed to irrigate approximately 105,000 acres of land. The country is rolling, with considerable slope to the north and west. The irrigable area comprises a number of benches and flats with abrupt declivities separting them. Some smoothing and floating is required before irrigating the land. The soils consist of red sandy, gravelly, and adobe and clay loams. The adobe and clay soils are located mainly on the east side of the Uncompahgre River and are suitable for raising alfalfa, grains, and sugar beets. The river bottom soils are peculiarly adapted to onions, sugar beets, and garden products. The red sandy and gravelly soils on the west side of the river are generally suited to all crops, but are usually devoted to high-priced crops, such as fruits, potatoes, and onions.

The principal crops grown are alfalfa, wheat, potatoes, onions, oats, corn, barley, apples, and sugar beets. Alfalfa yields from 2 to 5 tons per acre; wheat, oats, corn and barley, approximately 30 bushels; potatoes, from 175 to 250 bushels; onions, from 300 to 450 bushels; and sugar beets from 8 to 16 tons per acre. The furrow system of irrigation is used exclusively in this valley. Stock raising is one of the principal industries on the project. Dairying is an important industry and is increasing. Poultry farming is becoming an important industry. Concentrated products, such as butterfat, cheese, and sugar, are safe lines of production because of long distances to markets and consequent high transportation charges. The Uncompahgre Valley is bordered on nearly all sides by table-lands that afford summer range for cattle and sheep. There are also within a short distance of the project large areas of forests that are controlled by the United States Forest Service and leased on favorable terms to stockmen.

The project is served industrially by 3 flour mills, 1 radium sampler, 3 creameries, 2 brick and tile plants, 3 elevators, 1 canning factory, 2 cheese factories, 1 sugar factory, and 1 artificial ice plant. Both Montrose and Delta Counties have farm bureaus and employ county agents. The projects offers opportunity for canning factories, cheese plants, box mills, alfalfa mills, and other industries which could utilize the many products grown. The Denver & Rio Grande Western Railroad bisects the project, and good roads extend throughout the project and to neighboring towns over which auto freight lines are operated. The Pike's Peak Ocean to Ocean Highway, a part of the transcontinental highway system of the country, passes through the project. Livestock is marketed at Denver, Omaha, and Kansas City. Sugar beets are sent to the factory at Delta, and potatoes, onions, and fruit are shipped to Denver and eastern points. Local mining camps offer a market for vegetables and garden products, and alfalfa is fed to stock or disposed of locally to stockmen.

Montrose, the county seat of Montrose County, has a population of 3,502. Other project towns are Delta and Olathe, having populations of 2,700 and 750, respectively. These towns have chambers of commerce and luncheon clubs and are progressive. The farm population in 1929 was 5,750. Twenty-seven schools serve the project, 19 of which are in the rural districts. Accredited high schools are located in the 3 towns above mentioned. The principal religious denominations are represented and have churches in the towns of the project. The Uncompahgre Valley is located in one of the most picturesque sections of America. The San Juan Mountains are within a 2 hours' drive from Montrose. Excellent trout fishing and hunting are found in the mountains near by. The Gunnison River is noted for its scenery and fishing.

Harvesting barley on a farm near Nampa, Boise project, Idaho

IDAHO, BOISE PROJECT

THE Boise project is located in southwestern Idaho and eastern Oregon adjacent to the city of Boise. The general elevation of the project is 2,500 feet above sea level. The temperature rarely goes below zero or above 100°. The winters are generally mild and free from wind. The summers are long, sunshiny, and warm, and, with irrigation, plant growth is rapid. The precipitation at Boise for the past 65 years has averaged 13.4 inches per year.

On the Arrowrock division the principal engineering feature is Arrowrock Dam and Reservoir, which is located on the Boise River about 22 miles in a northeasterly direction from Boise, Idaho, and supplies water to the Boise project. The area of the reservoir is 2,800 acres and the capacity 280,000 acre-feet. The length of the spillway is 402 feet, and is constructed to pass 40,000 second-feet of water during floods. This dam is a concrete gravity section arched structure of the following principal dimensions: Height, 349 feet; base width, 223 feet; least width near top, 16 feet; crest length, 1,100 feet; arch radius at top, 672.5 feet. It contains 585,000 cubic yards of concrete. There is a 16-foot roadway across the top of the dam. Construction was begun in the spring of 1911 and completed in November, 1915. The outflow from the reservoir is controlled by two sets of ten 58-inch balanced valves, which discharge water through the dam at elevations 100 and 187 feet, respectively, below the spillway crest. In connection with the construction of this dam 17 miles of railroad were built, connecting the nearest point of the Oregon Short Line with the work. The cost of the dam complete, including the spillway and outlet works, was $4,327,710.

A complete distribution system has been constructed to supply water to the individual farms. The water supply is obtained from the natural flow of the Boise River, supplemented by flood water stored in Arrowrock and Deer Flat Reservoirs. About 165,000 acres have a full water right and some stored water is delivered to 110,000 additional acres. This land is all in private ownership and practically all is in cultivation. The topography is smooth or gently rolling and well suited to irrigation. The soils are variable in texture and composition, ranging from clay loam to sandy loam, and are usually deep and fertile.

Alfalfa is the standard field crop, of which an average yield of about 4 tons per acre is obtained. A large amount of wheat, barley, and clover seed is grown. Corn produces a heavy crop either of grain or ensilage. Both early and late potatoes are produced in large quantities. Head lettuce, cabbage, celery, melons, peas, and onions are grown commercially. Dairying and poultry raising are profitable and rapidly increasing in importance. Dairying especially is favored by the mild climate and the long growing season for pasture and forage crops. A large milk condensary, five creameries, and two cheese factories take care of the dairymen's produce. Livestock kept on the farm is increasing and large numbers of range stock are brought into the valley for winter feeding from the surrounding open range where summer pasture is usually good and cheap.

The main line of the Oregon Short Line Railroad extends through the project from east to west, with branch lines connecting all the project towns. Gravel and hard-surface highways have been constructed and truck and bus lines serve all parts of the valley. Most of the alfalfa, corn, and barley are fed on the farms, while the greater part of the fruit, potatoes, clover seed, and like crops are shipped to interior points and eastern markets. Livestock, poultry, and dairy products are usually marketed on the Pacific coast.

Boise has a population of 20,460; Nampa, 8,128; Caldwell, 4,860; and Parma, Meridian, Kuna, Melba, Notus, and Wilder are all thriving towns on or adjacent to the project. The farm population is about 15,000. School facilities are excellent. All of the towns have grade schools and high schools. The College of Idaho is located at Caldwell and has a large attendance. In Boise there are St. Margaret's Hall, St. Teresa's Academy, and a well-equipped business college. The mountains adjoining the project on the north and east offer excellent opportunities for camping, hunting, and fishing.

The Payette division, comprising 48,000 acres, depends for its water supply on the Payette River. No canals have yet been built to water these lands, but a diversion dam and power plant have been completed at Black Canyon, near Emmett, Idaho, and a storage reservoir in the Deadwood Basin is under construction.

IDAHO, KING HILL PROJECT

THE King Hill project is located along the Snake River in the southwestern part of Idaho. The climate of the district is mild. The temperature rarely goes below zero and the summers are long and warm, considering the latitude. The average annual precipitation is about 9 inches. The elevation of project lands averages about 2,600 feet above sea level. The main canal is about 50 miles long and contains a number of wood-stave pipe and reinforced concrete siphons and has approximately 10 miles of concrete flume and 9 miles of concrete lining. The capacity of this canal is 300 second-feet. The laterals are short and deliver water to each farm.

The water supply for irrigation is obtained from the Malad River, but is passed to the project canal by the Idaho Power Co. Domestic water is obtained from the canals or hauled from the river. Artesian water is obtainable at considerable depths.

Approximately 8,000 acres are under irrigation. The lands of the project are generally rolling, with some smooth areas. Soils vary in texture from sandy loam to clay, the latter type occupying the lower and smoother sections.

Virtually all crops which can be grown in temperate zones yield well on the King Hill project. Early springs and mild winters permit the production of early vegetables. Corn yields heavily for either grain or ensilage and wheat and oats do well. Alfalfa, the standard field crop, produces an average of 4 tons per acre, corn yields about 50 bushels, oats and barley about 35 to 40 bushels, and wheat 20 to 30 bushels. The project is surrounded by more or less desert areas of large extent that produce scant but nutritive grasses upon which thousands of sheep range during the greater part of the year. This range stock furnishes a means of disposing of a considerable portion of the hay grown on the project lands.

The Oregon Short Line Railway traverses the entire length of the project and furnishes a good outlet to Pacific coast and eastern markets. The Oregon Trail highway passes through the project from east to west and connects the district with Boise and Pacific coast points.

Towns on the project are Glenns Ferry, Hammett, and King Hill. Glenns Ferry has a population of about 1,408 and is larger than the others mentioned. The schools on the project are modern. The principal religious denominations are represented with organizations and places of worship, which also furnish centers for community and social life. A few hours' ride in an automobile enables one to reach the timber-covered mountains.

IDAHO, MINIDOKA PROJECT

THE Minidoka project is located in south-central Idaho, on both sides of Snake River. In 1904 it was an uninhabited sagebrush desert. It is now a fertile and productive area, with an annual gross production of from $3,500,000 to $4,500,000. The climate is dry and invigorating, with sunshine prevailing for a large part of the year. Temperatures rarely exceed 100° F. The average number of clear days each year is 263. The average frost-free period is 132 days, and the average elevation of the irrigable area is 4,225 feet above sea level.

The water supply for irrigation is derived from the direct flow of Snake River, supplemented by storage in Lake Walcott at the Minidoka diversion dam of 95,000 acre-feet; in Jackson Lake, Wyo., south of Yellowstone Park, with 847,000 acre-feet capacity; and in American Falls Reservoir, also on Snake River, with 1,700,000 acre-feet. At Minidoka Dam a Government power plant develops 13,000 horsepower and provides 1,200 farmers, besides all towns on the project, with cheap electricity. At this point also water is diverted to complete canal systems on both sides of the river that deliver water to each individual farm. On the north side of the river is an area of 65,000 acres irrigated by gravity; on the south side 49,000 acres are irrigated by electrically-driven pumps with three lifts, and 7,500 acres are irrigated by gravity.

The Gooding division, construction of which was started in 1928, comprises approximately 40,000 acres of land without water right lying north of the Twin Falls North Side project, and 45,000 acres of land in the vicinity of Shoshone and Gooding having a partial water supply from Wood River. Water for this division will be secured from the American Falls Reservoir (described on p. 4) with diversion at Milner Dam into a 70-mile main canal.

The lands, in general, have a gentle slope toward the river, with sufficient grade to facilitate irrigation and drainage. The soil types vary from loose sandy loam to very fine sandy and clay loam.

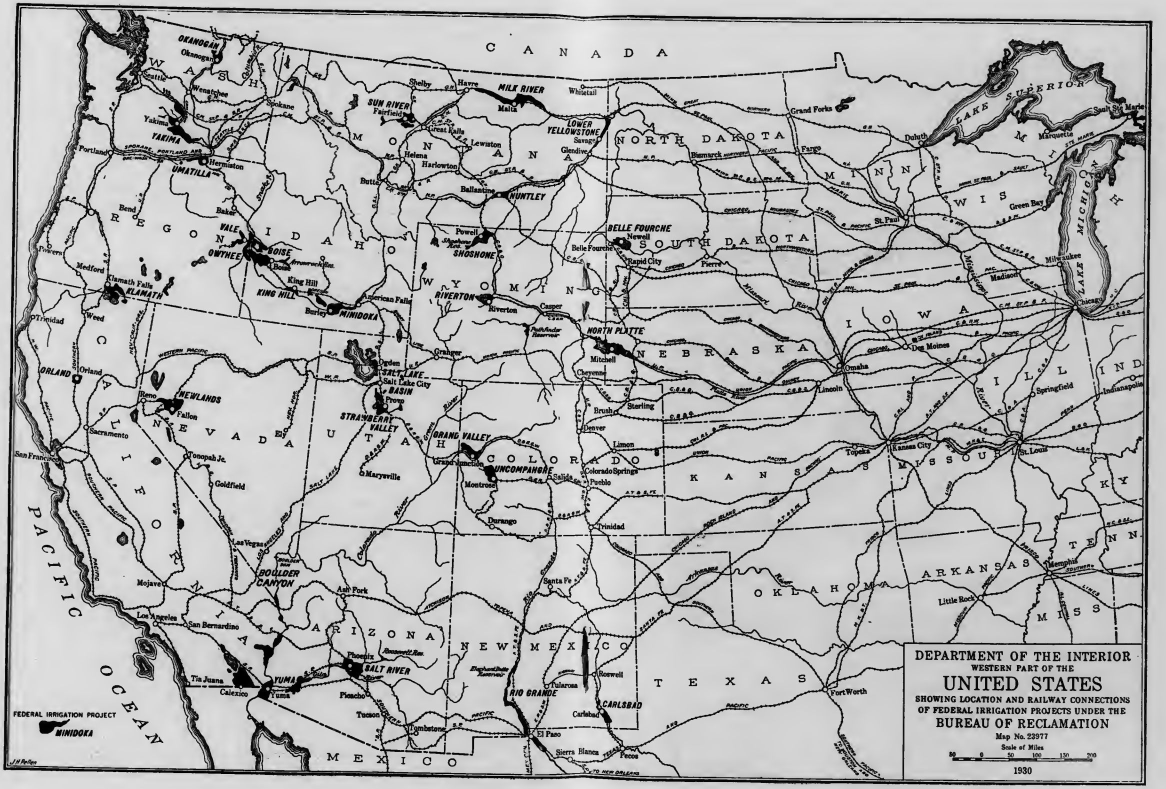
During the past 10 years the principal crops grown, with average yields per acre, have been: Wheat, 32 bushels; oats, 38 bushels; barley, 36 bushels; potatoes, 194 bushels; sugar beets, 10 tons; and alfalfa, 3 tons. The most satisfactory results come from diversification of crops in a well-planned rotation, together with dairying, hogs, and poultry. Considerable money is made in fattening sheep and cattle. The absence of extreme weather conditions and the light precipitation make more or less ideal conditions for the production of livestock and poultry of all kinds. Turkeys do exceptionally well. The inland location of the project and consequent high freight rates also favor the consumption of bulky crops at home. Dairying is an important industry and is rapidly increasing.

Two sugar factories have been established on the project, one at Burley and the other at Paul. Large quantities of milk and cream are shipped to creameries at Jerome and to Twin Falls and Pocatello, Idaho. One cheese factory is operating at Paul and another at Rupert, and casein plants, for the utilization of skim milk, are in operation at Burley and Rupert. Extensive feeding of livestock is done at the yards of the Portland Feeder Co. near the sugar factories. An alfalfa-meal mill and large flour mill operate at Burley and there is also an alfalfa-meal mill at Rupert.

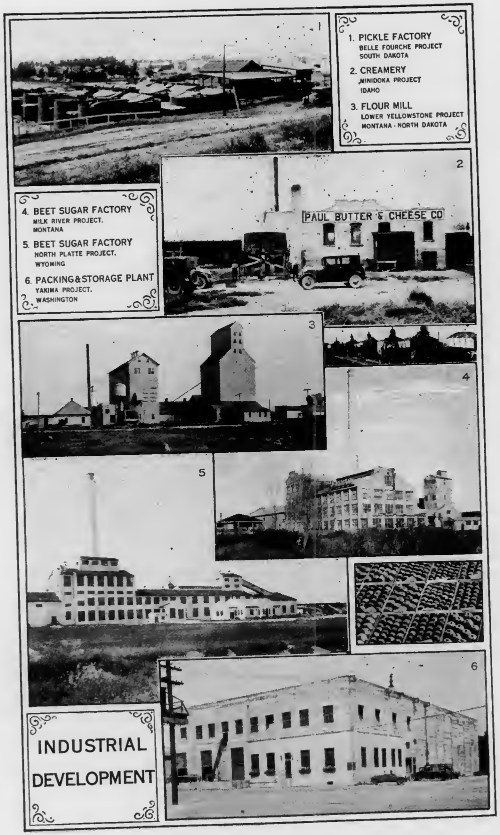
The main line of the Oregon Short Line Railroad serves the lands of the Minidoka project. From Minidoka a branch line to the Twin Falls section runs through the heart of the project. The Rupert-Bliss cut-off diverges at Rupert and runs westward across the north side gravity division. Two branch lines extend east and southeast from Burley, one of them running to Declo and Idahome, the other to Oakley.

The principal towns on the project are Burley, Rupert, Paul, Heyburn, Declo, and Acequia. The schools at Burley, Rupert, and Paul are exceptionally good, and accredited high schools are operated in the 3 towns. High schools are also conducted at Heyburn and Declo. In 1929 there were 16 schools on the gravity division and 7 schools on the South Side pumping division. There are 50 churches on the project representing the leading denominations. Other organizations, such as lodges, granges, clubs, and improvement associations, are numerous and well distributed.

The Bureau of Reclamation maintains a small park at Minidoka Dam, which is a favorite recreation center for the people on the project. It is adjacent to Lake Walcott, where fishing, boating, and bathing may be enjoyed. Both American Falls and Jackson Lake Reservoirs offer similar opportunities for water sports. The mountains north and south of the project afford many fine camping sites, and big game hunting is popular in the vicinity of Jackson Lake.



DEPARTMENT OF THE INTERIOR
WESTERN PART OF THE
UNITED STATES
SHOWING LOCATION AND RAILWAY CONNECTIONS
OF FEDERAL IRRIGATION PROJECTS UNDER THE
BUREAU OF RECLAMATION
Map No. 23977
Scale of Miles
50 0 50 100 150 200
1930



1. PICKLE FACTORY
BELLE FOURCHE PROJECT
SOUTH DAKOTA
2. CREAMERY
MINIDOKA PROJECT
IDAHO
3. FLOUR MILL
LOWER YELLOWSTONE PROJECT
MONTANA - NORTH DAKOTA

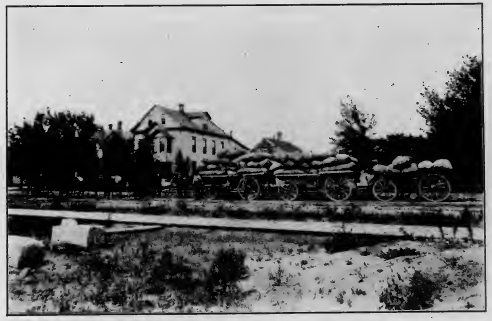
4. BEET SUGAR FACTORY
MILK RIVER PROJECT.
MONTANA
5. BEET SUGAR FACTORY
NORTH PLATTE PROJECT.
WYOMING
6. PACKING&STORAGE PLANT
YAKIMA PROJECT.
WASHINGTON

INDUSTRIAL DEVELOPMENT

MONTANA, HUNTLEY PROJECT

THE Huntley project is in Yellowstone County, Mont., and extends along the south side of the Yellowstone River east of Billings. The climate is variable; the winters are sometimes open and mild, with little snowfall, although at other times they may be more severe. The length of the growing season is approximately 135 days between killing frosts, and the annual precipitation averages 13 inches. The altitude is 3,000 feet above sea level.

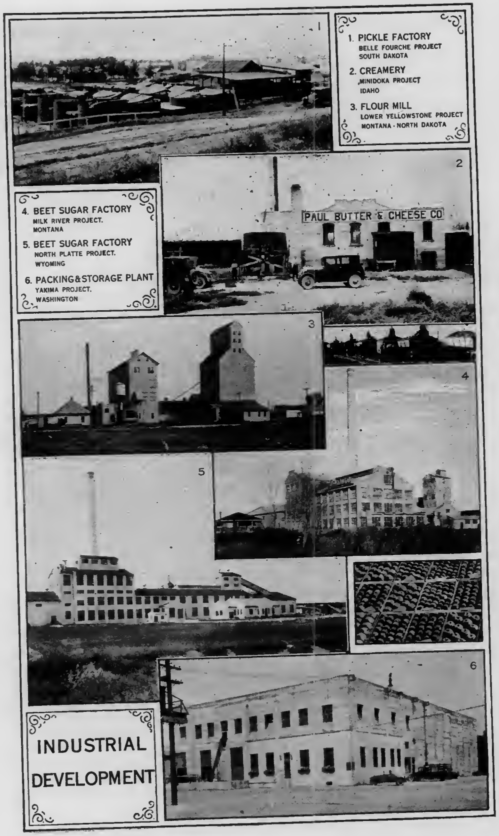
The main canal, which has a capacity of 500 second-feet, diverts water from the Yellowstone River. Storage water is not necessary because of the abundance of water in the river. Two pumping plants near Ballantine lift 100 second-feet of water into the high-line canal, which serves about 5,400 acres. Domestic water is obtained from shallow wells and cisterns, which are filled from the canal system. The water in the tile drains also serves as a domestic supply.



Wool shipments from Huntley project to Billings, Mont.

The project comprises an area of 32,500 acres of land lying in a compact body that facilitates irrigation and social development. The surface of the land is generally level and smooth, with slopes of 10 to 25 feet per mile. Such grades make irrigation practice simple. The soil is generally heavy and of a good quality. Alkali is prevalent on some of the land, and such land should not be acquired by the inexperienced.

Crops adaptable to the region include sugar beets, alfalfa, wheat, corn, beans, and potatoes. Small fruits, vegetables, sweet corn, tomatoes, cucumbers, squash, cantaloupes, and watermelons have been grown in considerable quantities and mature successful. Averly-



1. PICKLE FACTORY
BELLE FOURCHE PROJECT
SOUTH DAKOTA
2. CREAMERY
MINIDOKA PROJECT
IDAHO
3. FLOUR MILL
LOWER YELLOWSTONE PROJECT
MONTANA - NORTH DAKOTA

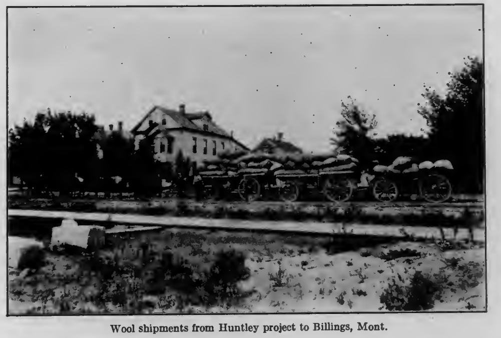
4. BEET SUGAR FACTORY
MILK RIVER PROJECT.
MONTANA
5. BEET SUGAR FACTORY
NORTH PLATTE PROJECT.
WYOMING
6. PACKING&STORAGE PLANT
YAKIMA PROJECT.
WASHINGTON

INDUSTRIAL DEVELOPMENT

MONTANA, HUNTLEY PROJECT

THE Huntley project is in Yellowstone County, Mont., and extends along the south side of the Yellowstone River east of Billings. The climate is variable; the winters are sometimes open and mild, with little snowfall, although at other times they may be more severe. The length of the growing season is approximately 135 days between killing frosts, and the annual precipitation averages 13 inches. The altitude is 3,000 feet above sea level.

The main canal, which has a capacity of 500 second-feet, diverts water from the Yellowstone River. Storage water is not necessary because of the abundance of water in the river. Two pumping plants near Ballantine lift 100 second-feet of water into the high-line canal, which serves about 5,400 acres. Domestic water is obtained from shallow wells and cisterns, which are filled from the canal system. The water in the tile drains also serves as a domestic supply.


Wool shipments from Huntley project to Billings, Mont.

The project comprises an area of 32,500 acres of land lying in a compact body that facilitates irrigation and social development. The surface of the land is generally level and smooth, with slopes of 10 to 25 feet per mile. Such grades make irrigation practice simple. The soil is generally heavy and of a good quality. Alkali is prevalent on some of the land, and such land should not be acquired by the inexperienced.

Crops adaptable to the region include sugar beets, alfalfa, wheat, corn, beans, and potatoes. Small fruits, vegetables, sweet corn, tomatoes, cucumbers, squash, cantaloupes, and watermelons have been grown in considerable quantities and mature successful. Averlyage yields over a 10-year period are as follows: Beets, 9.5 tons; alfalfa, 2.5 tons; wheat 18.5 bushels; beans, 20 bushels; and potatoes, 107 bushels. Maximum yields are about twice the average. The climate is suitable for livestock growing, and dairying is a profitable industry. Sheep feeding is also one of the chief enterprises. Adjacent to the project are extensive areas of pasture land which may be grazed from early spring until November.

Beets are shipped to the sugar factory at Billings. Cream and milk are delivered by trucks to the creamery at Worden and the cheese factory at Ballantine. The Project Supply Co. of Osborn is a cooperative organization which handles produce, coal, grain, etc.

The Northern Pacific and Chicago, Burlington & Quincy Railroads serve the project. The highways are generally well graded and kept in good condition. The Yellowstone Trail, which traverses the project, is an excellent graveled highway connecting local towns and Billings. The total length of gravel roads on the project is 56 miles. The principal markets are the mining towns in the State and the large cities in the Mississippi Valley.

There are 5 small towns on the project, as follows: Worden, Ballantine, Huntley, Pompeys Pillar, and Nibbe. The population on the farms is about 1,800, and that of the towns is about 700. Billings is a distributing center and is 15 miles from the project. The project is served with good schools. An accredited high school is maintained at Worden, the geographical center of the project. Under the consolidated system all children of school age are transported to the centralized schools, which are well equipped with teachers and demonstration material. Established churches are to be found in all the towns; the outlying districts are also served by the pastors from these centers. Community buildings located at Ballantine and Osborn serve as meeting places for settlers to conduct their business or for social gatherings. The Osborn community building was constructed during 1928 by the Huntley Project Picnic Association at a cost of $4,200, which was paid in full at that time.

For the first 20 years, or until January 1, 1928, the project was operated by the Government. Since that time it has been operated under the supervision of the board of directors of the Huntley Project Irrigation District in accordance with the provisions of the contract between the United States and the district. The district was organized under the laws of the State of Montana and includes all of the irrigable area of the project.

MONTANA, MILK RIVER PROJECT

THE Milk River project is located in northeastern Montana parallel to and about 50 miles south of the Canadian boundary, in the vicinity of Glasgow and Malta. Temperatures vary from 100°

in the summer to −40° in winter, although winters are not so severe as the temperature indicates; stock ordinarily graze in the open throughout the year. The usual frost-free period is from May 20 to September 10. Notwithstanding the comparatively short growing period, the season is favorable for rapid plant growth owing to the long summer days. The average annual precipitation at Malta is 13.85 inches, approximately 10 inches of which occur during the growing season. The average elevation is 2,200 feet.

Water from the Sherburne Lakes Reservoir to supplement the flow of the St. Mary and Milk Rivers is carried through a canal for a distance of 30 miles and delivered to the Milk River, which passes through Canadian territory for 216 miles and then returns to the United States, where the water is taken out for use on the project by means of low diversion dams.

A sugar-beet field on the Milk River project, Montana

The bureau is now prepared to serve about 116,000 acres, 40 per cent of which is actually irrigated. The project occupies a long narrow valley on each side of the Milk River. As a rule the land is very smooth, with a relatively flat slope. The soil of the Milk River Valley, with very few exceptions, is fine in texture. Immediately adjacent to the river it is classed as silt loam or fine sandy loam; this gradually changes into a fine textured loam or clay, which merges into a very fine soil locally termed "gumbo" in the localities most age yields over a 10-year period are as follows: Beets, 9.5 tons; alfalfa, 2.5 tons; wheat 18.5 bushels; beans, 20 bushels; and potatoes, 107 bushels. Maximum yields are about twice the average. The climate is suitable for livestock growing, and dairying is a profitable industry. Sheep feeding is also one of the chief enterprises. Adjacent to the project are extensive areas of pasture land which may be grazed from early spring until November.

Beets are shipped to the sugar factory at Billings. Cream and milk are delivered by trucks to the creamery at Worden and the cheese factory at Ballantine. The Project Supply Co. of Osborn is a cooperative organization which handles produce, coal, grain, etc.

The Northern Pacific and Chicago, Burlington & Quincy Railroads serve the project. The highways are generally well graded and kept in good condition. The Yellowstone Trail, which traverses the project, is an excellent graveled highway connecting local towns and Billings. The total length of gravel roads on the project is 56 miles. The principal markets are the mining towns in the State and the large cities in the Mississippi Valley.

There are 5 small towns on the project, as follows: Worden, Ballantine, Huntley, Pompeys Pillar, and Nibbe. The population on the farms is about 1,800, and that of the towns is about 700. Billings is a distributing center and is 15 miles from the project. The project is served with good schools. An accredited high school is maintained at Worden, the geographical center of the project. Under the consolidated system all children of school age are transported to the centralized schools, which are well equipped with teachers and demonstration material. Established churches are to be found in all the towns; the outlying districts are also served by the pastors from these centers. Community buildings located at Ballantine and Osborn serve as meeting places for settlers to conduct their business or for social gatherings. The Osborn community building was constructed during 1928 by the Huntley Project Picnic Association at a cost of $4,200, which was paid in full at that time.

For the first 20 years, or until January 1, 1928, the project was operated by the Government. Since that time it has been operated under the supervision of the board of directors of the Huntley Project Irrigation District in accordance with the provisions of the contract between the United States and the district. The district was organized under the laws of the State of Montana and includes all of the irrigable area of the project.

MONTANA, MILK RIVER PROJECT

THE Milk River project is located in northeastern Montana parallel to and about 50 miles south of the Canadian boundary, in the vicinity of Glasgow and Malta. Temperatures vary from 100° in the summer to −40° in winter, although winters are not so severe as the temperature indicates; stock ordinarily graze in the open throughout the year. The usual frost-free period is from May 20 to September 10. Notwithstanding the comparatively short growing period, the season is favorable for rapid plant growth owing to the long summer days. The average annual precipitation at Malta is 13.85 inches, approximately 10 inches of which occur during the growing season. The average elevation is 2,200 feet.

Water from the Sherburne Lakes Reservoir to supplement the flow of the St. Mary and Milk Rivers is carried through a canal for a distance of 30 miles and delivered to the Milk River, which passes through Canadian territory for 216 miles and then returns to the United States, where the water is taken out for use on the project by means of low diversion dams.

A sugar-beet field on the Milk River project, Montana

The bureau is now prepared to serve about 116,000 acres, 40 per cent of which is actually irrigated. The project occupies a long narrow valley on each side of the Milk River. As a rule the land is very smooth, with a relatively flat slope. The soil of the Milk River Valley, with very few exceptions, is fine in texture. Immediately adjacent to the river it is classed as silt loam or fine sandy loam; this gradually changes into a fine textured loam or clay, which merges into a very fine soil locally termed "gumbo" in the localities most remote from the river. The silt loam is highly productive and easy to work. The intermediate type, though productive, is somewhat refractory, whereas the "gumbo" soil is often the least productive and most difficult to till. Good land can be purchased very cheaply with reasonable terms of payment, and exceedingly liberal contracts for the repayment of project construction costs have been granted.

The better lands are adapted to diversified farming in units of from 100 to 160 acres, and upon the more refractory soils dairying or stock feeding is the most profitable practice, with units varying from 160 to 640 acres. Alfalfa, small grains, hardy vegetables, and sugar beets can be profitably produced. The latter crop is particularly adapted to the project, good yields with a high sugar content being obtained. About 5,000 acres of this product are grown each year, with the acreage gradually expanding as the lands become prepared for the crop. Seed potatoes and alfalfa seed are produced with very good results in favorable years. Livestock raising, including beef and dairy cattle, hogs, and sheep, is the principal industry. Owing to the abundance of good summer range the project is well adapted to livestock. The summer grazing herds of both cattle and sheep can be profitably fed and fattened for market during the winter months on the produce from the project lands.

There are 2 flour mills, 2 creameries, 1 sugar factory, a seed growers' association, a potato growers' association, a livestock marketing association, and 3 active farm bureau organizations on the project. When completely developed the project should support another sugar factory, additional creameries, and several cheese factories. Excellent marketing and transportation facilities are provided by the main line of the Great Northern Railroad, which traverses the center of the project from east to west. Towns and sidings are located at distances of 5 or 6 miles along the line. The "T. R. Highway," or highway No. 2, the official Northern Transcontinental Highway, provides an excellent automobile road throughout the entire length of the project.

Electrical energy for power, lighting, and cooking is supplied to the towns and rural communities by the Montana Power Co. at very reasonable rates. Natural gas developed from a number of wells on the project furnishes the towns and many of the farms with cheap, convenient fuel.

There is a local demand for practically all of the hay, dairy products, potatoes, and vegetables produced upon the project. A convenient market for grain and livestock is provided at St. Paul, Minneapolis, and Duluth, all within a very direct and reasonable freight haul. A local sugar factory easily handles the entire beet production and returns to the farmer, at a reasonable cost, factory by-products for feeding operations.

The principal towns and populations are as follows: Glasgow, 2,209; Malta, 1,265; Chinook, 1,317; Harlem, 707; Saco, 506; Hinsdale, 400; Nashua, 351. These towns all have the usual modern conveniences, such as electrical energy, natural gas, and water and sewer systems. The social and educational advantages offered are comparable with other towns of like size throughout the country. Excellent high schools and grade schools are maintained and all the principal religious denominations are represented. The present farm population is about 1,500, but the project should support at least 2,500.

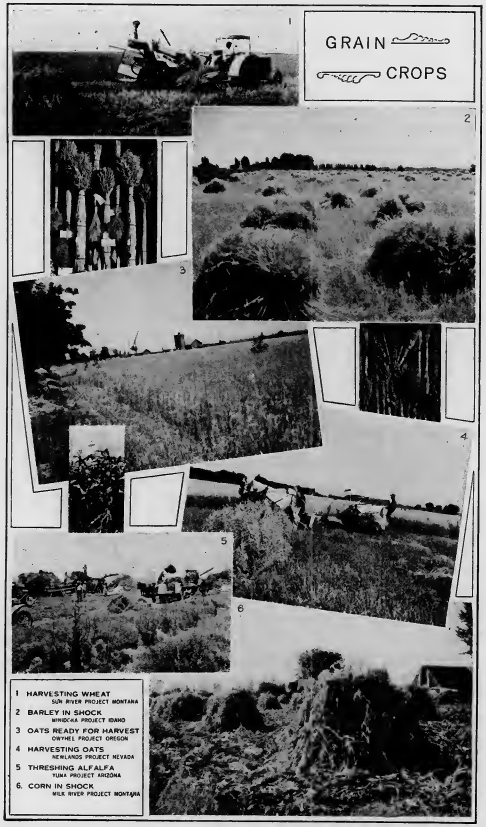
Recreation in the way of excellent hunting and fishing is offered by the many small lakes and streams of the vicinity. Glacier National Park, Waterton Lakes National Park in southern Alberta, and the adjacent mountainous region, all within one day's travel over excellent graveled roads, offer ample opportunity for the enjoyment of summer vacations and outings.

MONTANA, SUN RIVER PROJECT

THE Sun River project is located in Teton and Cascade Counties, Mont., lying west of the city of Great Falls. The average elevation of the irrigable area is 3,900 feet above sea level. The climate is healthful and exhilarating, and although the temperature may range from 40° below to 100° above zero, extreme low temperatures are unusual and occur only for short periods, and the nights are always cool. The average rainfall is approximately 11 inches, a large portion of which occurs from April to July. The average frost-free period is from May 20 to September 15, but the long days of sunshine give a vigorous growing season.

The project is divided into two principal divisions, one comprising the lands south of Sun River in what is called the Fort Shaw division and the other, with a much larger area, comprising the lands north of Sun River, including what are known as Greenfields, Mill Coulee, Big Coulee, and Sun River Slope divisions. The Fort Shaw division diverts water from Sun River a few miles west of Simms. The north side divisions are all irrigated from the same main canal which diverts water from Sun River at the entrance to Sun River Canyon in the Rocky Mountains.

The water supply is considered fully adequate, water rights to the natural flow of the river being supplemented by Gibson, Willow Creek, and Pishkun Reservoirs. Gibson Reservoir, in Sun River Canyon, is the main reservoir and has a capacity of 90,000 acre-feet, which can, by placing gates on the spillway, be enlarged to 105,000 acre-feet. Willow Creek Reservoir is located downstream from the diversion to north side lands, and has a capacity of 16,700 acre-feet. Pishkun Reservoir is in the nature of an equalizing reservoir at mile



GRAIN CROPS

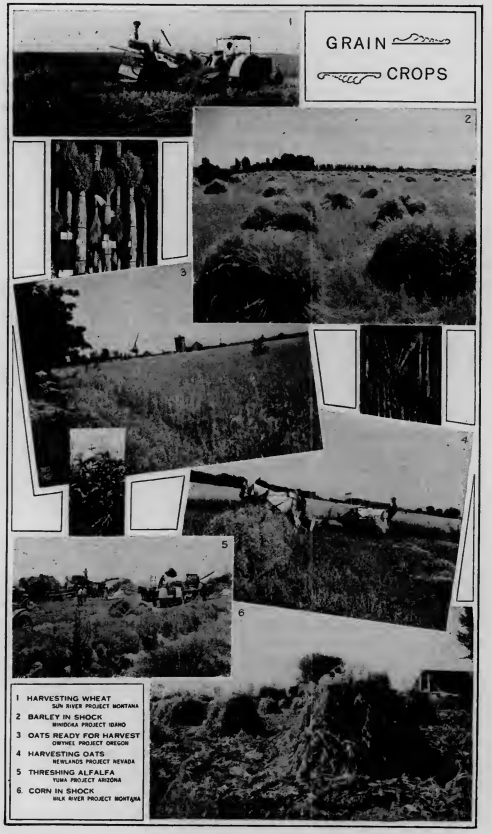
1 HARVESTING WHEAT SUN RIVER PROJECT MONTANA
2 BARLEY IN SHOCK MINIDOKA PROJECT IDAHO
3 OATS READY FOR HARVEST OWYHEE PROJECT OREGON
4 HARVESTING OATS NEWLANDS PROJECT NEVADA
5 THRESHING ALFALFA YUMA PROJECT ARIZONA
6. CORN IN SHOCK MILK RIVER PROJECT MONTANA

12.5 on the main canal for north side lands, and in 1930 was enlarged to a capacity of 21,000 acre-feet. It is not planned to operate Willow Creek Reservoir at present, as Gibson Reservoir has a capacity sufficient for all project lands now under irrigation. Domestic water is usually obtained from wells.

Irrigation works have been constructed for 56,000 acres, of which 14,000 acres are in the Fort Shaw division and 42,000 acres in the Greenfields division. When there is a demand for more irrigated farms the lateral system will be extended to serve an additional area of 33,000 acres in the Greenfields division and 18,000 acres in the Sun River Slope division. No subsurface drains have been built on the Fort Shaw division. On the Greenfields division 28 miles of drains have been constructed to protect from seepage the area now being irrigated. Additional drains, which, upon investigation, are found to be feasible, will be built as required. The project lands are well adapted to irrigated farming, having a smooth surface, with a sufficient slope to facilitate handling the water. Very little special work has to be done in getting the land ready for irrigation. The soils range from a light clay or silt loam to a heavy clay loam with occasional gravel. They are fertile and give good results when properly farmed. The principal crops are alfalfa, sweetclover, grain, and vegetables. Sugar beets may become an important crop in time. Good yields are obtained from all staple crops that are adapted to this section of the Northwest.

The canal system on the Fort Shaw division is operated by the irrigation district. The construction charges are $30 and $34.63 per acre, the annual installments being based on 5 per cent of the average gross acre income received from crops. On the Greenfields division the same repayment plan is followed, but the construction charge may be in excess of $90 per acre, the exact amount depending upon the final construction cost. The annual installments will be small and no interest accrues on deferred payments. The canal system on the Greenfields division has been operated by the Government, but will be turned over to the district on January 1, 1931.

On account of cold winters it is desirable to provide shelter and feed for all kinds of livestock. Many settlers are making money in raising cattle, hogs, and sheep, and dairying has been an important activity for many years. Free range in the immediate vicinity of the project is a thing of the past, but large tracts of unentered public land are advertised at the beginning of the year and leased for 5-year periods to the highest bidders. At Willow Creek Reservoir and Pishkun Reservoir there are areas of about 4,000 acres each that furnish excellent pasturage. An association of the stock raisers on the project has leased the pasture at Willow Creek and pastures stock belonging to water users on the project at a rate of 75 cents per month



GRAIN CROPS

1 HARVESTING WHEAT SUN RIVER PROJECT MONTANA
2 BARLEY IN SHOCK MINIDOKA PROJECT IDAHO
3 OATS READY FOR HARVEST OWYHEE PROJECT OREGON
4 HARVESTING OATS NEWLANDS PROJECT NEVADA
5 THRESHING ALFALFA YUMA PROJECT ARIZONA
6. CORN IN SHOCK MILK RIVER PROJECT MONTANA

12.5 on the main canal for north side lands, and in 1930 was enlarged to a capacity of 21,000 acre-feet. It is not planned to operate Willow Creek Reservoir at present, as Gibson Reservoir has a capacity sufficient for all project lands now under irrigation. Domestic water is usually obtained from wells.

Irrigation works have been constructed for 56,000 acres, of which 14,000 acres are in the Fort Shaw division and 42,000 acres in the Greenfields division. When there is a demand for more irrigated farms the lateral system will be extended to serve an additional area of 33,000 acres in the Greenfields division and 18,000 acres in the Sun River Slope division. No subsurface drains have been built on the Fort Shaw division. On the Greenfields division 28 miles of drains have been constructed to protect from seepage the area now being irrigated. Additional drains, which, upon investigation, are found to be feasible, will be built as required. The project lands are well adapted to irrigated farming, having a smooth surface, with a sufficient slope to facilitate handling the water. Very little special work has to be done in getting the land ready for irrigation. The soils range from a light clay or silt loam to a heavy clay loam with occasional gravel. They are fertile and give good results when properly farmed. The principal crops are alfalfa, sweetclover, grain, and vegetables. Sugar beets may become an important crop in time. Good yields are obtained from all staple crops that are adapted to this section of the Northwest.

The canal system on the Fort Shaw division is operated by the irrigation district. The construction charges are $30 and $34.63 per acre, the annual installments being based on 5 per cent of the average gross acre income received from crops. On the Greenfields division the same repayment plan is followed, but the construction charge may be in excess of $90 per acre, the exact amount depending upon the final construction cost. The annual installments will be small and no interest accrues on deferred payments. The canal system on the Greenfields division has been operated by the Government, but will be turned over to the district on January 1, 1931.

On account of cold winters it is desirable to provide shelter and feed for all kinds of livestock. Many settlers are making money in raising cattle, hogs, and sheep, and dairying has been an important activity for many years. Free range in the immediate vicinity of the project is a thing of the past, but large tracts of unentered public land are advertised at the beginning of the year and leased for 5-year periods to the highest bidders. At Willow Creek Reservoir and Pishkun Reservoir there are areas of about 4,000 acres each that furnish excellent pasturage. An association of the stock raisers on the project has leased the pasture at Willow Creek and pastures stock belonging to water users on the project at a rate of 75 cents per month for each mature animal. They also plan tentatively to lease the pasture at Pishkun Reservoir for this purpose when the land is again available for lease.

The project is traversed by three lines of the Great Northern Railway and by the Chicago, Milwaukee & St. Paul. The gravel surface road from the Yellowstone National Park to Glacier National Park runs through the project. The principal towns tributary to the lands now under irrigation are Sun River, population 40; Fort Shaw, 80; Simms, 125; and Fairfield, 115.

Great Falls, with over 28,500 people, is the second largest city in the State and is growing both industrially and in population. The project has good schools, and at Simms there is a Smith-Hughes course. An associate county agent located at Fairfield assists the water users in their farm development programs. Good work among the younger generation is carried on under the direction of the 4-H clubs. Several of the leading denominations have established churches on the project. Great Falls offers recreation and trading facilities to the settlers, and a few hours' drive is all that is needed to reach Glacier National Park or many other fine summer resorts where good fishing and hunting may be found during the open season.

MONTANA-NORTH DAKOTA, LOWER YELLOWSTONE PROJECT

THE Lower Yellowstone project lies along the west side of the Yellowstone River in eastern Montana and extends into North Dakota. The latitude is 48° N., and winters are sometimes severe, although tempered by warm chinook winds. The average of the highest and lowest temperatures recorded during the past 24 years is 103° and −34° F., respectively. The average precipitation for the same period is 14 inches. The frost-free period averages 129 days. Owing to the latitude, the days in summer are long. The average elevation of the project is 1,900 feet above sea level.

The diversion dam is located about 18 miles below Glendive, Mont., on the Yellowstone River, and the main canal extends from that point to the Missouri River, a distance of about 71 miles. A direct-connected hydraulic pumping plant near Savage, Mont., furnishes water for 2,300 acres of bench lands. The irrigable area of the project is about 59,000 acres, and the lateral system delivers water to each farm. The Yellowstone River provides an abundance of water for irrigation. Domestic and stock water may be obtained from shallow wells. The topography of the district is generally flat, with just sufficient fall to facilitate irrigation. The soil varies from a sandy loam to clay loam; it is fertile, deep, and easily worked. Limited areas have become water-logged, but these are being relieved by an extensive drainage system which is nearly completed.

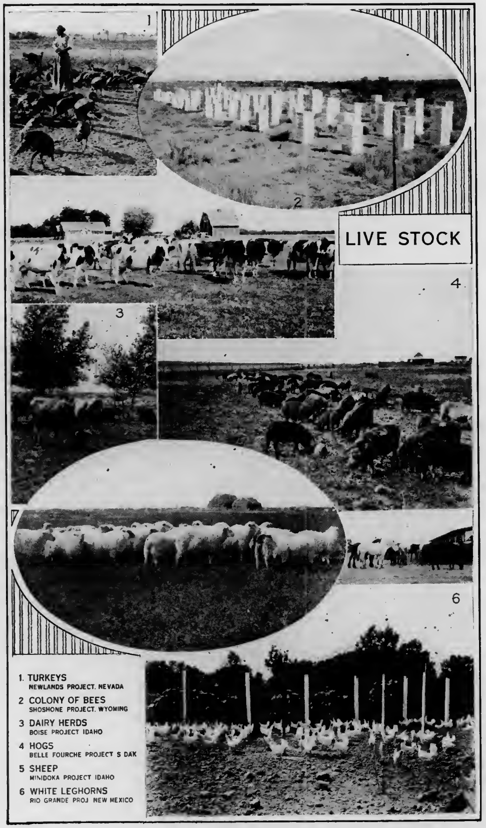
The principal crops are alfalfa, sugar beets, cereals, corn, and potatoes. The yields of these crops are generally good and range from 20 to 40 bushels of wheat, 2 to 4 tons of alfalfa, 30 to 40 bushels of corn, 3 to 6 tons of potatoes, and 8 to 15 tons of sugar beets. Truck and berries do well. The climate and general conditions are suitable for stock raising and dairying, but, on account of the long winter seasons, good shelter should be provided. Sheep do especially well, and the fattening of lambs for market on alfalfa, beet tops, beet pulp, and grain is a profitable industry. Cheap forage crops make dairying profitable. Surrounding the project are large areas of semiarid rolling plains covered with native grasses that support many thousands of sheep and cattle. For the ambitious project farmer this large grazing territory furnishes an opportunity to expand his stock-raising program beyond the capacity of his irrigated farm. Range stock feeding furnishes a market for the hay grown by the settlers.

A branch line of the Northern Pacific Railway runs from Glendive to Sidney and meets a branch line of the Great Northern Railway, thus giving the project a railway throughout its entire length. A well-graded highway runs through the project, connecting with the Roosevelt National Highway on the north and the Yellowstone Trail on the south. The principal outside markets are Seattle, Duluth, Minneapolis, and Chicago. A beet-sugar factory at Sidney handles all of the beets raised on the project. Much of the project wheat is milled at a large flour mill also located at Sidney.

The principal towns are Sidney and Fairview, with populations of 2,000 and 700, respectively. Savage, Crane, and Dore are stations on the railroad. The farm population is about 1,600, which is not enough to utilize fully the lands of this project. Montana is known for its good schools, and the Lower Yellowstone project is not backward in this regard. There are 17 schools and 19 churches on the project. High schools are located at Savage, Sidney, and Fairview. Fishing in the Yellowstone River and hunting for ducks along the sloughs appeal to the sportsman. The mountains in the western part of the State offer attractions for vacations and summer camping trips.

NEBRASKA-WYOMING, NORTH PLATTE PROJECT

THE North Platte project is located in the valley of the North Platte River, in western Nebraska and eastern Wyoming. The irrigable land lies in Goshen County, Wyo., and Scotts Bluff, Sioux, and Morrill Counties in Nebraska, and covers a territory approximately 100 miles long and 25 miles in width at the widest part. The settlement of the valley was begun in the eighties, and since the advent of irrigation, both by private and Government enterprise, has developed rapidly. The altitude varies from 3,800 to 4,500 feet above sea level. The climatic conditions are such as to make the project an



LIVE STOCK

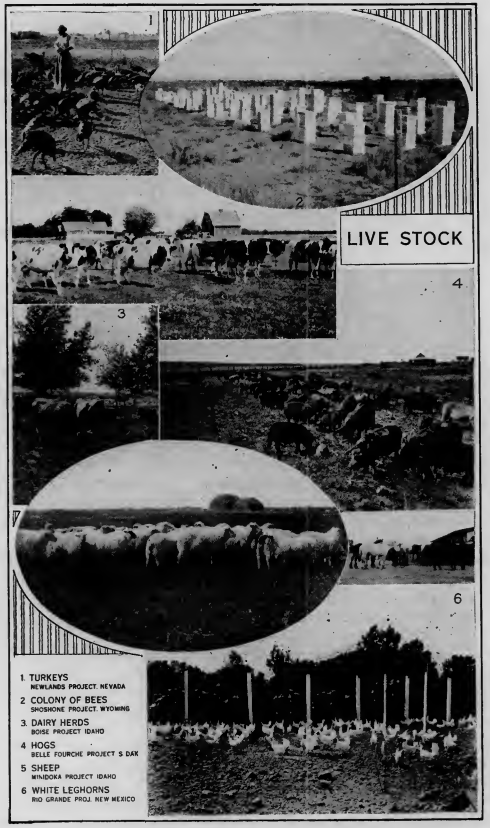
1. TURKEYS
NEWLANDS PROJECT, NEVADA
2 COLONY OF BEES
SHOSHONE PROJECT, WYOMING
3 DAIRY HERDS
BOISE PROJECT IDAHO
4 HOGS
BELLE FOURCHE PROJECT S DAK
5 SHEEP
MINIDOKA PROJECT IDAHO
6 WHITE LEGHORNS
RIO GRANDE PROJ NEW MEXICO

agreeable place in which to live. The summers are usually warm and dry. Little extremely warm weather occurs, and then for only short periods. The average rainfall is 15.27 inches, the greater part falling during the growing season. The snowfall is usually light and stays on the ground for short periods. The length of the irrigation season is from April 1 to September 30.

Water for irrigation is obtained by the storage of flood water of the North Platte River and the Pathfinder and Guernsey Reservoirs. The Pathfinder Reservoir covers an area of 22,700 acres and has a capacity of 1,070,000 acre-feet at spillway level. The Pathfinder Dam is one of the largest masonry dams in the world, rising 218 feet above its rock foundation. Water is released as required and flows down the North Platte River for a distance of 165 miles to the Guernsey Reservoir. The Guernsey Reservoir has a storage capacity of 71,060 acre-feet. This reservoir is used for regulating purposes, being located 10 miles above the Whalen diversion dam, where water is diverted into canals and carried to the project lands. The Fort Laramie Canal is 130 miles long and has an initial capacity of 1,550 second-feet. The Interstate Canal is 95 miles long and has a capacity of 2,200 second-feet. There are 810 miles of canals and laterals on the Interstate division and 702 on the Fort Laramie division. The irrigable area under the Interstate Canal is 114,000 acres and under the Fort Laramie is 107,000 acres. The Northport district contains 16,000 acres of irrigable land. The total irrigable area of the project is 237,000 acres.

The project is composed of four irrigation districts organized under the laws of the States of Wyoming and Nebraska. These irrigation districts have assumed the operation and maintenance of the irrigation works of the project. The storage system, the diversion dam at Whalen, and the power system are designated as reserved works and are operated and maintained by the United States. Electrical energy developed at the Guernsey power plant, located at the Guernsey Dam, and the Lingle power plant, operated by water carried through the Fort Laramie Canal, is furnished to a number of the towns and farming communities on the project.

The topography in general is rolling, with a large percentage of moderately sloping land, some flat, and some very steep areas. The soils vary from light sandy to heavier or gumbo soils. The greater part of the soil is a sandy loam of excellent quality, free from alkali and other injurious substances. It is easily worked and particularly well adapted to the raising of fine potatoes and sugar beets. The soils are very productive and raise large yields of all crops adapted to the climate.



LIVE STOCK

1. TURKEYS
NEWLANDS PROJECT. NEVADA
2 COLONY OF BEES
SHOSHONE PROJECT. WYOMING
3. DAIRY HERDS
BOISE PROJECT IDAHO
4 HOGS
BELLE FOURCHE PROJECT S DAK
5 SHEEP
MINIDOKA PROJECT IDAHO
6 WHITE LEGHORNS
RIO GRANDE PROJ. NEW MEXICO

agreeable place in which to live. The summers are usually warm and dry. Little extremely warm weather occurs, and then for only short periods. The average rainfall is 15.27 inches, the greater part falling during the growing season. The snowfall is usually light and stays on the ground for short periods. The length of the irrigation season is from April 1 to September 30.

Water for irrigation is obtained by the storage of flood water of the North Platte River and the Pathfinder and Guernsey Reservoirs. The Pathfinder Reservoir covers an area of 22,700 acres and has a capacity of 1,070,000 acre-feet at spillway level. The Pathfinder Dam is one of the largest masonry dams in the world, rising 218 feet above its rock foundation. Water is released as required and flows down the North Platte River for a distance of 165 miles to the Guernsey Reservoir. The Guernsey Reservoir has a storage capacity of 71,060 acre-feet. This reservoir is used for regulating purposes, being located 10 miles above the Whalen diversion dam, where water is diverted into canals and carried to the project lands. The Fort Laramie Canal is 130 miles long and has an initial capacity of 1,550 second-feet. The Interstate Canal is 95 miles long and has a capacity of 2,200 second-feet. There are 810 miles of canals and laterals on the Interstate division and 702 on the Fort Laramie division. The irrigable area under the Interstate Canal is 114,000 acres and under the Fort Laramie is 107,000 acres. The Northport district contains 16,000 acres of irrigable land. The total irrigable area of the project is 237,000 acres.

The project is composed of four irrigation districts organized under the laws of the States of Wyoming and Nebraska. These irrigation districts have assumed the operation and maintenance of the irrigation works of the project. The storage system, the diversion dam at Whalen, and the power system are designated as reserved works and are operated and maintained by the United States. Electrical energy developed at the Guernsey power plant, located at the Guernsey Dam, and the Lingle power plant, operated by water carried through the Fort Laramie Canal, is furnished to a number of the towns and farming communities on the project.

The topography in general is rolling, with a large percentage of moderately sloping land, some flat, and some very steep areas. The soils vary from light sandy to heavier or gumbo soils. The greater part of the soil is a sandy loam of excellent quality, free from alkali and other injurious substances. It is easily worked and particularly well adapted to the raising of fine potatoes and sugar beets. The soils are very productive and raise large yields of all crops adapted to the climate.

The soil and climate are favorable for the growing of practically any Temperate Zone crop. The principal crops raised are, in the order of the acreage devoted to each, alfalfa, sugar beets, barley, corn, potatoes, oats, and wheat. The large amount of alfalfa and grain produced, and the sugar-beet tops, pulp, and sirup from the sugar factories have made the feeding of cattle and sheep a profitable industry. More than 300,000 sheep and 50,000 head of cattle have been fed in the valley in one season. There is also a growing interest in purebred cattle and hogs. There are five cooperative cheese factories on the project and a centralizing plant for shipping purposes. Under existing favorable conditions, the dairy industry offers good opportunities for settlers. Fine herds of both grade and purebred hogs are to be found on the project. Poultry, including turkey raising, is also profitable. Turkeys are marketed through the North Platte Valley Cooperative Poultry Marketing Association, 15 to 20 carloads being shipped each year.

The project is surrounded by a grass-covered plain devoted to the grazing of stock during the greater part of the year and furnishing both a supply of feeders and a market for the hay grown on the project.

There are 7 sugar factories on the project. Beet dumps are conviently located along the two main railroads and several branch lines have been constructed to bring beet-dump service within convenient hauling distance of all of the land. The branch lines are also utilized for other farm produce and for loading carload lots of livestock. The Burlington and Union Pacific Railways traverse the project from east to west, the former paralleling the river on the north and the latter on the south side of the project. A branch line of the Union Pacific Railway connects the project with Cheyenne and Denver. The surplus crops and farm products find markets in Casper, Denver, Omaha, Kansas City, Chicago, and other large cities which are accessible through railway transportation. The North Platte Valley Highway, which runs the full length of the project, and a large mileage of graded county roads make the remotest parts of the project easily and quickly accessible.

The cities and towns to which the project lands are tributary with their population are Bridgeport, 1,362; Northport, 100; Bayard, 1,559; Minitare, 1,080; Scottsbluff, 8,474; Mitchell, 2,055; Morrill, 756; Henry, 167; Gering, 2,528; Haig, 50; and Lyman 656, in Nebraska; and Torrington, 1,811; Lingle, 415; Fort Laramie, 245; Huntley, 16; Yoder, 266; Veteran, 13; and Cottier, 11, in Wyoming. Good educational and social advantages may be enjoyed, such as would not be available in a smaller and less highly developed community. The total population of the district is about 45,000.

NEVADA, NEWLANDS PROJECT

THE Newlands project is located in western Nevada in what is known as the Lahontan Valley, a portion of which embraces an area commonly designated as the Carson Sink. It is surrounded by mountains on all sides, on the west being the timber and snow-clad peaks of the Sierra Nevadas. The general elevation of the project lands is about 4,000 feet above sea level. The temperature ranges from 0° to 105° F. Owing to the altitude, late and early frosts are to be expected, but these ordinarily do not interfere with the successful growing of a great variety of crops.

The principal engineering features are the control dam at Lake Tahoe; the diversion dam in the Truckee River near Derby; the Truckee Canal, 31 miles in length; the Lahontan Dam and Reservoir on the Carson River; the Carson diversion dam, a vast network of over 500 miles of canals and laterals for delivering water to each farm unit in the project; and a system of approximately 250 miles of deep open drains. Water for irrigation is obtained from the Truckee and Carson Rivers and Lahontan Reservoir, in which the flows of these streams are combined. The total project area consists of 87,500 acres of agricultural lands and 50,000 acres of pasture lands. Approximately 65,000 acres are covered by water-right applications, of which about 50,000 acres were irrigated in 1929.

The topography and soils of the project are variable, ranging from extensive areas of clay-loam soil with uniform gradual slope to areas of more rolling topography over which sandy-loam soils predominate. The lands in general are very fertile and alkali and seepage conditions are readily controlled by drainage facilities.

The principal crop is alfalfa, about which center cattle, sheep, and hog feeding, dairying, and the alfalfa-meal industries. An 18,000-acre community pasture is operated and maintained by the Truckee-Carson irrigation district and several smaller pastures are cooperatively or privately utilized. Much of the prosperity of the project is attributed to the dairy industry. Project-grown dairy stock are in constant demand on the Pacific coast and are found to be practically free of tuberculosis. The feeding value of the alfalfa grown is so high that this product is used almost exclusively as a livestock feed ration. Alfalfa is cut three times in a season, the average yield being approximately 3½ tons per acre, although yields of 5 or more tons are produced on the better prepared lands.

Excellent yields of wheat, barley, and corn are obtained.

Asparagus, celery, and cantaloupes are commercially grown. A wide variety of garden truck and small fruits are also raised.

This is an ideal location for poultry, rabbit, and stock raising. The moderate winters, with their freedom from severe storms and light precipitation, make housing facilities inexpensive and insure maximum returns from feed consumed.

Increasing numbers of range cattle and sheep are brought into the project for winter feeding and fattening. Large numbers of rabbits are successfully raised and marketed.

Owing to favorable climatic conditions, the poultry and turkey industries have become of major importance. Approximately 50,000 turkeys are raised each year, most of which are carefully graded, packed, and marketed as Diamond "N" turkeys by the Nevada Turkey Growers' Association. Fallon turkeys have brought the highest prices in Pacific coast markets and are in great demand on account of the high quality.

Good markets for all farm produce are available and transportation facilities are excellent.

Improved roads and highways, which are maintained by the county and the State, have facilitated the moving and marketing of products. The Victory and Lincoln highways cross the project. The principal markets are Pacific coast cities and the towns and mining camps in Nevada.

Electricity for project towns and farm use is furnished by the hydroelectric plant at Lahontan Dam, with stand-by service being rendered over a tie line connecting the Lahontan plant with lines operated by the Sierra Pacific Power Co. at Virginia City, Nev. Largely as the result of the formation of local improvement districts, rural power lines have been constructed and are serving most of the project farms.

The city of Fallon, on the project, has a population of more than 1,700. Other project towns are Hazen and Fernley, on the main line of the Southern Pacific Railroad, and Stillwater. At Fallon are three large grammar schools and a fine county high school. Consolidated schools in Fallon serve the surrounding country, busses being used for transportation.

For recreation, Lake Tahoe, of world-wide fame, and Pyramid, Winnemucca, and Walker Lakes, all of considerable size and beauty, are only a few hours distant by automobile. Excellent hunting and fishing may be enjoyed in the surrounding mountains, lakes, and streams.

The operation and maintenance and control of the project was assumed by the Truckee-Carson irrigation district on December 31, 1926, under a contract with the United States.

NEW MEXICO, CARLSBAD PROJECT

THE Carlsbad project is located in southeast New Mexico in the valley of the Pecos River between the Guadalupe Mountains and the Staked Plains. The project is in Eddy County, of which Carlsbad is the county seat. The elevation of the land is about 3,100 feet above sea level. The yearly temperature ranges from 4° F. below zero to 112° F. above. The average annual rainfall for a period of 28 years is 13.3 inches. The maximum rainfall occurs in June, July, and August. Snowfall is light and rarely stays on the ground more than a few days. The autumn and winter months are delightful. The summer days are sometimes hot, but the nights are cool. The average growing season is 210 days. The average date of the last killing frost in the spring is April 1 and that of the first killing frost in the fall is October 25.

The main canal is 25 miles long, the last 7½ miles being lined with concrete. Water is delivered to each 40-acre farm. The water supply for the project is furnished by the Pecos River, the winter flow of which is stored in McMillan and Avalon Reservoirs. The area of irrigated land is limited by the amount of water available. Water for domestic and stock use is obtained from the irrigation canals.

The irrigable area of the project is 25,000 acres, all of which is in private ownership and nearly all cultivated or irrigated. The topography is smooth, with gentle slopes, and is admirably suited to irrigation. The soils range from light sandy loam to clay loam and contain a high lime content. They are friable and easy to work and the better types are very fertile.

The climatic and soil conditions on the Carlsbad project are conducive to a wide range of crops. At present cotton and alfalfa predominate. Cereals, corn, and garden truck do well; and fruits, such as apples, pears, peaches, and grapes, are grown successfully. Well-farmed land produces from 3 to 6 tons of alfalfa per acre and from one-half to 1½ bales (500 pounds) of cotton. Maximum yields exceed 2 bales per acre. The average gross value of the latter for the five years 1925 to 1929, inclusive, was $65.25 per acre. Many of the farmers are finding it profitable to feed alfalfa and cottonseed meal to stock, thus realizing a substantial profit for their products. There are several thriving dairies on the project. Hog raising is proving a profitable business. Owing to the mild winters and dry atmosphere, stock of all kinds thrives and can be raised profitably on the project. A chicken ranch on the project with pens for 10,000 chickens supplies this vicinity with eggs. A chick hatchery with a capacity of 50,000 chicks is a part of the equipment. There are eight cotton gins and two hydroelectric plants on the project, and a cottonseed crushing plant, located at Loving near the center of the project, assures the farmer a ready market for cottonseed.

The Carlsbad project is surrounded by grazing land that furnishes both summer and winter range for large numbers of cattle and sheep. The national forest reserves in the mountains also furnish summer grazing for a considerable number of cattle.

The Santa Fe Railroad passes through the project, and the State highway follows the railroad. The small acreage of irrigated land in this section of the country, compared with the large surrounding range territory, insures a good market at home for much of the hay and grain grown. Carlsbad has a population of 3,500, and is the principal town. Loving and Malaga are also project towns. There are seven grammar schools on the project and a central high school located at Carlsbad. Most of the church denominations and fraternal organizations are represented on the project.

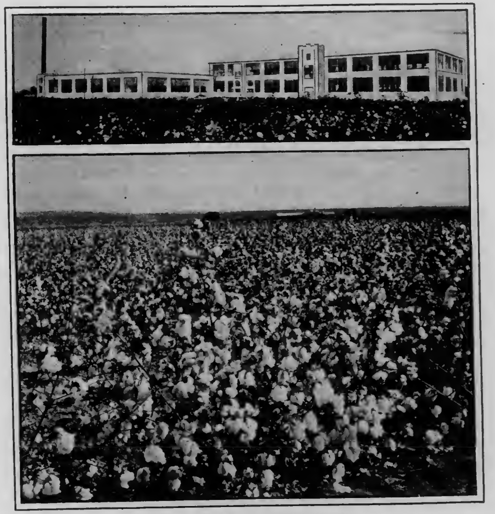
Carlsbad and vicinity offer exceptional opportunities for hunting, fishing, swimming, and boating. The Pecos and Black Rivers, within the confines of the project, offer excellent fishing for catfish and black bass. A day's trip from the project carries the hunter into the Sacramento and Guadalupe Mountains, where deer and black bear are common. Excellent quail and duck shooting may be had in season in the country immediately surrounding the project. The Carlsbad Cavern, believed to be the largest limestone cavern in the country, if not in the world, is located 26 miles southwest of Carlsbad. The cavern is in charge of the National Park Service.

NEW MEXICO-TEXAS, RIO GRANDE PROJECT

THE Rio Grande project is located in New Mexico and Texas, adjacent to the city of El Paso on the Mexican border. It lies in a river valley of rich alluvial soil extending from about 100 miles north to about 50 miles south of El Paso. A healthful and agreeable all-year climate, with an abundance of sunshine, is one of the principal attractions of the project, which is located on the table-lands of the great continental plateau and has an elevation ranging from 3,600 to 4,100 feet. The summer temperature is modified by the low humidity, moderately high altitude, and by frequent summer showers. The winters are short, dry, and open, permitting outdoor work. There are no climatic extremes, and severe storms, cyclones, and other major weather disturbances are unknown. The lowest winter temperature is 10° F. above zero and the highest summer temperature 102° F. The average annual rainfall is 8.6 inches, and the average length of frost-free period is 198 days, from April 9 to October 24.

The outstanding engineering feature of the project is the Elephant Butte storage dam and reservoir. The project's abundant and very reliable water supply for irrigation comes from the regulated flow of the Rio Grande. Flood waters are stored by the Elephant Butte Dam and released as required. A complete irrigation distribution system of canals and laterals delivers water to the farms. An extensive and satisfactory drainage system has relieved seepage conditions on most of the lands needing it. Domestic water is obtained from shallow wells.

The project comprises about 155,000 acres, exclusive of 25,000 acres in Mexico. The area irrigated at present is about 142,000 acres. The lands are all in private ownership. The surface topography of the Rio Grande Valley is generally flat, and comparatively little leveling is necessary before irrigation can be effected. The soils consist of generally fertile alluvial material laid down by the Rio Grande, ranging from sand to adobe in texture, graded according to the geological conditions under which it was deposited.



Rio Grande project, New Mexico-Texas
Above: El Paso Cotton Textile Mill, with cotton field in foreground
Below: Cotton in bloom

The Rio Grande project offers good opportunities to settlers because the soil and climate will grow practically any Temperate Zone crop. Alfalfa has been the standard field crop, of which an average yield of

The Carlsbad project is surrounded by grazing land that furnishes both summer and winter range for large numbers of cattle and sheep. The national forest reserves in the mountains also furnish summer grazing for a considerable number of cattle.

The Santa Fe Railroad passes through the project, and the State highway follows the railroad. The small acreage of irrigated land in this section of the country, compared with the large surrounding range territory, insures a good market at home for much of the hay and grain grown. Carlsbad has a population of 3,500, and is the principal town. Loving and Malaga are also project towns. There are seven grammar schools on the project and a central high school located at Carlsbad. Most of the church denominations and fraternal organizations are represented on the project.

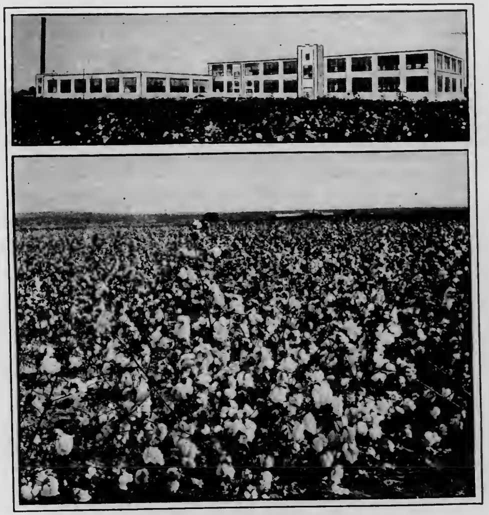
Carlsbad and vicinity offer exceptional opportunities for hunting, fishing, swimming, and boating. The Pecos and Black Rivers, within the confines of the project, offer excellent fishing for catfish and black bass. A day's trip from the project carries the hunter into the Sacramento and Guadalupe Mountains, where deer and black bear are common. Excellent quail and duck shooting may be had in season in the country immediately surrounding the project. The Carlsbad Cavern, believed to be the largest limestone cavern in the country, if not in the world, is located 26 miles southwest of Carlsbad. The cavern is in charge of the National Park Service.

NEW MEXICO-TEXAS, RIO GRANDE PROJECT

THE Rio Grande project is located in New Mexico and Texas, adjacent to the city of El Paso on the Mexican border. It lies in a river valley of rich alluvial soil extending from about 100 miles north to about 50 miles south of El Paso. A healthful and agreeable all-year climate, with an abundance of sunshine, is one of the principal attractions of the project, which is located on the table-lands of the great continental plateau and has an elevation ranging from 3,600 to 4,100 feet. The summer temperature is modified by the low humidity, moderately high altitude, and by frequent summer showers. The winters are short, dry, and open, permitting outdoor work. There are no climatic extremes, and severe storms, cyclones, and other major weather disturbances are unknown. The lowest winter temperature is 10° F. above zero and the highest summer temperature 102° F. The average annual rainfall is 8.6 inches, and the average length of frost-free period is 198 days, from April 9 to October 24.

The outstanding engineering feature of the project is the Elephant Butte storage dam and reservoir. The project's abundant and very reliable water supply for irrigation comes from the regulated flow of the Rio Grande. Flood waters are stored by the Elephant Butte Dam and released as required. A complete irrigation distribution system of canals and laterals delivers water to the farms. An extensive and satisfactory drainage system has relieved seepage conditions on most of the lands needing it. Domestic water is obtained from shallow wells.

The project comprises about 155,000 acres, exclusive of 25,000 acres in Mexico. The area irrigated at present is about 142,000 acres. The lands are all in private ownership. The surface topography of the Rio Grande Valley is generally flat, and comparatively little leveling is necessary before irrigation can be effected. The soils consist of generally fertile alluvial material laid down by the Rio Grande, ranging from sand to adobe in texture, graded according to the geological conditions under which it was deposited.



Rio Grande project, New Mexico-Texas
Above: El Paso Cotton Textile Mill, with cotton field in foreground
Below: Cotton in bloom

The Rio Grande project offers good opportunities to settlers because the soil and climate will grow practically any Temperate Zone crop. Alfalfa has been the standard field crop, of which an average yield of

4 tons per acre can be obtained. It is cut 5 times in a season. Cotton has now come to be the principal cash crop of the project. Cotton yields are high, averaging nearly a bale per acre, and the crop leads in acreage and total value of crops grown. Melons, fruits, and vegetables are shipped to eastern markets in car lots. Dairying occupies an important place in the agriculture of the district and is found profitable. A mild climate, low rainfall, and the great variety of forage crops make livestock growing attractive. The dry areas adjacent to the project afford some grazing, but cattle and sheep men depend on the irrigated area for feed when grass is short or fattening necessary.

A number of cooperative marketing and producing associations are in operation throughout the project. Growers of poultry, alfalfa, cotton, and melons are well organized. A large number of cotton gins and compresses serve the district. Several cottonseed-oil mills are located throughout the project and there is a cotton textile mill in El Paso. Electric energy is transmitted throughout the district. Three creameries operate on the project. Six main-line railroads enter El Paso. The Atchison, Topeka & Santa Fe Railway serves the Mesilla and Rincon Valleys in New Mexico. The Texas & Pacific and the Southern Pacific Railways, combined, bisect the El Paso Valley in Texas. The project is therefore well served with railroads to the principal markets. Good roads pass through the project and a number of auto-stage and freight-truck lines provide easy access to towns and facilitate the marketing of farm products. Several milk routes collect milk and cream daily for the El Paso market. Eastern Texas and the Southern States furnish a market for large quantities of alfalfa, hay and meal; melons and small fruits go to interior and eastern markets, and cotton to large centers requiring it. Cotton often brings a premium on account of its fine staple.

The city of El Paso has a population of 101,975. Farm communities near such a city enjoy the unusual combination of the opportunities afforded by new and undeveloped land and the life of a metropolis with the social, trading, and marketing facilities it provides. Las Cruces has a population of 5,799. There are 38 towns and railroad stations on the project outside of El Paso and Las Cruces. The most important of these are Canutillo, Ysleta, Clint, and Fabens, in Texas; and Hot Springs, Hatch, Anthony, and La Mesa, in New Mexico. There are 35 rural schools in Rincon and Mesilla Valleys and 12 in El Paso Valley. Several excellent high schools are located conveniently to all parts of the project. Las Cruces has a good high school and a convent. The New Mexico State College of Agriculture and Mechanic Arts and the agricultural experiment station are located near Mesilla Park. In addition to these, El Paso offers excellent educational advantages, including the Texas College of Mines. Cloudcroft and the Sacramento and Black Range Mountains to the north, with an elevation of about 8,000 feet and reached by good roads, furnish attractive summer resorts where fishing and hunting may be enjoyed. Elephant Butte Reservoir provides excellent fishing. El Paso is a city of historic and natural beauty, located opposite the old city of Paso Del Norte, now Juarez, Mexico.

OREGON, UMATILLA PROJECT

THE Umatilla project, located in northeastern Oregon, comprises two main divisions. The older, or eastern division, of 17,000 acres, lies east of the Umatilla River, and the western division, of 11,300 acres, extends from the mouth of the Umatilla River westerly along the Columbia River for about 20 miles. The climate is comparatively dry, with an average rainfall of 9 inches. The temperature during the summer months is frequently high, but the heat is not oppressive and the nights are cool. The winters are not severe. The altitude is 470 feet above sea level and the average frost-free period is 168 days.

The water supply for all of this district is the Umatilla River, with a mean annual run-off of 520,000 acre-feet. Cold Springs and McKay Dams constitute the most important engineering features. These reservoirs have a combined capacity of 125,000 acre-feet and furnish an ample supply of water for all project lands and a supplemental supply for 28,000 acres of privately owned land. All main canals and most of the laterals are concrete lined. The topography of the district is rolling and the surface is uneven and requires leveling to facilitate irrigation. The soil is sandy loam, reasonably fertile, free from alkali, and requires careful handling to prevent blowing.

The land is adapted to the growing of alfalfa, small fruits, corn, potatoes, and garden truck. The average yield per acre of alfalfa is about 4 tons. Three crops are usually harvested, and yields of 6 tons per acre are not uncommon. Corn and silage for stock feed, and potatoes, both early and late varieties, give good returns. The mild and dry climate of eastern Oregon is favorable for the production of livestock and poultry. Sheep feeding on the project is a profitable business, and dairying is carried on extensively. Excellent summer range for cattle and sheep is furnished by the surrounding dry lands and by the National Forest Reserve areas which are leased at low rates to stockmen.

The entire length of the project is traversed by the Oregon-Washington Railway & Navigation Co. and the Columbia Highway. Good roads lead to these main arteries of traffic, making markets for produce easily accessible. Portland, Oreg., is the principal market for grain, small fruits, truck, dairy products, and fat livestock. Local demand and the surrounding country consume a considerable amount of the produce grown on the project.

Hermiston, Umatilla, Irrigon, and Boardman are project towns. Hermiston is the largest, with a population of about 600. There are six schools on the project and free motor busses take children to and from school. Most of the religious denominations are represented and have buildings that serve as social centers. The Columbia Highway makes pleasure resorts easily accessible. Following this highway east, a few hours' drive takes one into the Blue Mountains, where a well-timbered country affords good fishing and hunting. Westward the highway runs along the Columbia River through unsurpassed scenery to Portland, Oreg.

The care and operation of the Umatilla project was turned over to the irrigation districts on July 1, 1926. Further information relating to the east division may be obtained by writing to the project manager at Hermiston, Oreg., and the west division by writing to the project manager at Irrigon, Oreg.

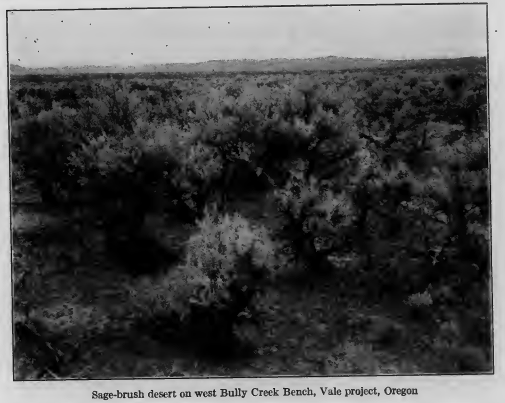
OREGON, VALE PROJECT

THE Vale project is located in Malheur County, eastern Oregon, and comprises 31,000 acres of irrigable land on the north side of the Malheur River between the towns of Namorf and Jamieson. The climate is mild, with an annual precipitation ranging from 7 to 15 inches, most of which falls during the months of October to January. The irrigable area has an average elevation of 2,370 feet above sea level. The water supply is obtained from the Malheur River, one of the large tributaries of the Snake.

The Warm Springs irrigation district has constructed the Warm Springs Reservoir, with a capacity of 170,000 acre-feet, on the middle fork of the Malheur River. This stored water, together with natural flow rights and return flow, provides an adequate supply of water for 18,000 acres of lower bench lands, which are irrigated by private canals, and also takes care of 21,000 acres under the Government canal system. The capacity of this reservoir was increased to 190,000 acre-feet in 1930. The United States has purchased not to exceed one-half of the stored water in Warm Springs Reservoir. To provide an adequate supply for all of the irrigable lands additional storage works must eventually be built and this can be accomplished by the construction of an earthen dam 100 feet high and a reservoir with a capacity of 60,000 acre-feet on the north fork of the Malheur River. Water is diverted into the main canal, 70 miles long, at Harper Diversion Dam, which has been built across the Malheur River about 1 mile above Namorf.

The major portion of the project is level, sagebrush, bench land with a fine sandy loam soil which takes up and retains water very well and is easy to till. All of the irrigable lands are within the boundaries of the Vale-Oregon irrigation district, which has contracted to repay to the United States, within 40 years from the date of a public notice, not yet announced, not to exceed $4,500,000, which is to be expended in the construction of the project. Assessments will not be uniform, but will be based within certain limits on productivity, the best lands carrying the highest charges.

The principal crops grown on the irrigable lands are alfalfa, grain, potatoes, truck, and fruit. In the Jamieson district apple, peach, and pear orchards have produced good yields. Alfalfa and clover grown for hay and seed have been found profitable. Potatoes and onions produce high yields, and truck crops, such as melons and head lettuce, return a good profit. Bluegrass and orchard grass grow rapidly on the irrigated lands and provide good pastures for cows and sheep. Beef cattle and sheep are pastured on the open range and forest reserves near the project during the summer season and in the fall are returned to the project to be fed for market. The climate is particularly suited to the production of turkeys and large shipments are made annually to eastern markets.


Sage-brush desert on west Bully Creek Bench, Vale project, Oregon

Vale, the principal town and county seat, has a population of about 900, with modern business establishments, a sanitarium, natatorium, good schools, churches, and all lines of ordinary professions reprefor grain, small fruits, truck, dairy products, and fat livestock. Local demand and the surrounding country consume a considerable amount of the produce grown on the project.

Hermiston, Umatilla, Irrigon, and Boardman are project towns. Hermiston is the largest, with a population of about 600. There are six schools on the project and free motor busses take children to and from school. Most of the religious denominations are represented and have buildings that serve as social centers. The Columbia Highway makes pleasure resorts easily accessible. Following this highway east, a few hours' drive takes one into the Blue Mountains, where a well-timbered country affords good fishing and hunting. Westward the highway runs along the Columbia River through unsurpassed scenery to Portland, Oreg.

The care and operation of the Umatilla project was turned over to the irrigation districts on July 1, 1926. Further information relating to the east division may be obtained by writing to the project manager at Hermiston, Oreg., and the west division by writing to the project manager at Irrigon, Oreg.

OREGON, VALE PROJECT

The Vale project is located in Malheur County, eastern Oregon, and comprises 31,000 acres of irrigable land on the north side of the Malheur River between the towns of Namorf and Jamieson. The climate is mild, with an annual precipitation ranging from 7 to 15 inches, most of which falls during the months of October to January. The irrigable area has an average elevation of 2,370 feet above sea level. The water supply is obtained from the Malheur River, one of the large tributaries of the Snake.

The Warm Springs irrigation district has constructed the Warm Springs Reservoir, with a capacity of 170,000 acre-feet, on the middle fork of the Malheur River. This stored water, together with natural flow rights and return flow, provides an adequate supply of water for 18,000 acres of lower bench lands, which are irrigated by private canals, and also takes care of 21,000 acres under the Government canal system. The capacity of this reservoir was increased to 190,000 acre-feet in 1930. The United States has purchased not to exceed one-half of the stored water in Warm Springs Reservoir. To provide an adequate supply for all of the irrigable lands additional storage works must eventually be built and this can be accomplished by the construction of an earthen dam 100 feet high and a reservoir with a capacity of 60,000 acre-feet on the north fork of the Malheur River. Water is diverted into the main canal, 70 miles long, at Harper Diversion Dam, which has been built across the Malheur River about 1 mile above Namorf.

The major portion of the project is level, sagebrush, bench land with a fine sandy loam soil which takes up and retains water very well and is easy to till. All of the irrigable lands are within the boundaries of the Vale-Oregon irrigation district, which has contracted to repay to the United States, within 40 years from the date of a public notice, not yet announced, not to exceed $4,500,000, which is to be expended in the construction of the project. Assessments will not be uniform, but will be based within certain limits on productivity, the best lands carrying the highest charges.

The principal crops grown on the irrigable lands are alfalfa, grain, potatoes, truck, and fruit. In the Jamieson district apple, peach, and pear orchards have produced good yields. Alfalfa and clover grown for hay and seed have been found profitable. Potatoes and onions produce high yields, and truck crops, such as melons and head lettuce, return a good profit. Bluegrass and orchard grass grow rapidly on the irrigated lands and provide good pastures for cows and sheep. Beef cattle and sheep are pastured on the open range and forest reserves near the project during the summer season and in the fall are returned to the project to be fed for market. The climate is particularly suited to the production of turkeys and large shipments are made annually to eastern markets.

Sage-brush desert on west Bully Creek Bench, Vale project, Oregon

Vale, the principal town and county seat, has a population of about 900, with modern business establishments, a sanitarium, natatorium, good schools, churches, and all lines of ordinary professions represented. Harper, at the upper end of the project, is an important shipping point for livestock and wool; Jamieson, at the eastern end, is a shipping point for livestock and fruit.

The project towns and lands are served by a branch of the Union Pacific system, which connects with the main line at Ontario, on the Snake River, and follows the Malheur River to Burns. Plans are being considered for the extension of this branch line from Burns to connect with the Southern Pacific near Crescent City. When such construction is completed it will provide a fairly direct route to California markets.

The John Day surfaced highway passes through Nyssa, Vale, Jamieson, and Brogan to Arlington, where it joins the Old Oregon Trail Highway and furnishes an excellent automobile thoroughfare to Portland and the Pacific coast. A route for a surfaced road, known as the Central Oregon State Highway, has been surveyed westward from Vale and has been constructed as far west as Harper. This road when completed will connect with the north and south highway from Bend to Klamath Falls, Oreg.

Alfalfa hay in stacks on cultivated land adjacent to the Vale project, Oregon

The project is within a few hours' automobile drive over a surfaced highway from the Blue Mountains, which offer many opportunities for camping, fishing, and hunting. Deer in the mountains and Chinese pheasants in the valleys are quite plentiful. Payette Lakes in Idaho, an attractive summer resort, may be reached in a half day's drive over a surfaced highway.

OREGON-CALIFORNIA, KLAMATH PROJECT

THE Klamath project is located in southern Oregon and northern California at the foot of the Cascade Mountains. Klamath and Lost Rivers, with the storage provided by Clear Lake, Gerber Reservoir, and Upper Klamath Lake, furnish an ample supply for the irrigated land. Klamath is noted for its equable climate, being both healthful and invigorating. The growing season is short, but the days are long and growth is rapid. Frosts may be expected until June and frequently occur in late September. The average annual precipitation is 12.8 inches. The elevation of the irrigable lands ranges from about 4,000 to 4,300 feet above sea level.

The principal engineering features of the project are the tunnel which carries the main canal through the hill in the city of Klamath Falls for a distance of 3,300 feet; the Lost River diversion dam; Clear Lake and Gerber storage dams; Link River diversion dam; and the 4,300-foot concrete flume on Canal C. The irrigable area of the project as now developed is 120,448 acres, which includes 20,000 acres of Lower Klamath Lake lands, where little progress has been made. The irrigated area for 1929 was 80,570 acres. When completed the project will contain 176,000 acres, including 54,000 acres of Lower Klamath Lake peaty soils. The topography of the lands is generally smooth, with gentle slopes, and preparation for irrigation is relatively inexpensive. The Tule Lake area, containing about 33,000 acres, of which a little more than half is already provided with irrigation works, is particularly smooth. The soils vary from sandy loam to peaty clay loam; they are fertile, easily worked, and do not contain high percentages of alkali. The surrounding country just outside of the project is rough and mountainous.

On account of the cool climate, small grains, forage crops, potatoes, and hardy vegetables are the principal crops. Two cuttings of alfalfa are grown, which yield from 2 to 4 tons per acre on the older lands of the project and from 3 to 6 tons in the Tule Lake section. Wheat yields from 20 to 40 bushels, barley from 30 to 60 bushels, and potatoes from 125 to 250 sacks per acre where properly handled. The large area of cheap range land and the favorable climate combine to make the Klamath district preeminently a stock and dairy country. Very little loss occurs from stock diseases, and the proximity of immense forests and sawmills insures comparatively cheap lumber for barns and sheds. The open ranges, together with the national forest reserves in this section of the State, which provide summer pasture, give opportunity for farmers to maintain more stock for feeding at reasonable prices. Dairying is a profitable business and well suited to the district. There are five creameries and two cheese factories on the project. Various organizations, such as potato growers, poultry growers, and cow-testing associations, have been formed.

sented. Harper, at the upper end of the project, is an important shipping point for livestock and wool; Jamieson, at the eastern end, is a shipping point for livestock and fruit.

The project towns and lands are served by a branch of the Union Pacific system, which connects with the main line at Ontario, on the Snake River, and follows the Malheur River to Burns. Plans are being considered for the extension of this branch line from Burns to connect with the Southern Pacific near Crescent City. When such construction is completed it will provide a fairly direct route to California markets.

The John Day surfaced highway passes through Nyssa, Vale, Jamieson, and Brogan to Arlington, where it joins the Old Oregon Trail Highway and furnishes an excellent automobile thoroughfare to Portland and the Pacific coast. A route for a surfaced road, known as the Central Oregon State Highway, has been surveyed westward from Vale and has been constructed as far west as Harper. This road when completed will connect with the north and south highway from Bend to Klamath Falls, Oreg.

Alfalfa hay in stacks on cultivated land adjacent to the Vale project, Oregon

The project is within a few hours' automobile drive over a surfaced highway from the Blue Mountains, which offer many opportunities for camping, fishing, and hunting. Deer in the mountains and Chinese pheasants in the valleys are quite plentiful. Payette Lakes in Idaho, an attractive summer resort, may be reached in a half day's drive over a surfaced highway.

OREGON-CALIFORNIA, KLAMATH PROJECT

THE Klamath project is located in southern Oregon and northern California at the foot of the Cascade Mountains. Klamath and Lost Rivers, with the storage provided by Clear Lake, Gerber Reservoir, and Upper Klamath Lake, furnish an ample supply for the irrigated land. Klamath is noted for its equable climate, being both healthful and invigorating. The growing season is short, but the days are long and growth is rapid. Frosts may be expected until June and frequently occur in late September. The average annual precipitation is 12.8 inches. The elevation of the irrigable lands ranges from about 4,000 to 4,300 feet above sea level.

The principal engineering features of the project are the tunnel which carries the main canal through the hill in the city of Klamath Falls for a distance of 3,300 feet; the Lost River diversion dam; Clear Lake and Gerber storage dams; Link River diversion dam; and the 4,300-foot concrete flume on Canal C. The irrigable area of the project as now developed is 120,448 acres, which includes 20,000 acres of Lower Klamath Lake lands, where little progress has been made. The irrigated area for 1929 was 80,570 acres. When completed the project will contain 176,000 acres, including 54,000 acres of Lower Klamath Lake peaty soils. The topography of the lands is generally smooth, with gentle slopes, and preparation for irrigation is relatively inexpensive. The Tule Lake area, containing about 33,000 acres, of which a little more than half is already provided with irrigation works, is particularly smooth. The soils vary from sandy loam to peaty clay loam; they are fertile, easily worked, and do not contain high percentages of alkali. The surrounding country just outside of the project is rough and mountainous.

On account of the cool climate, small grains, forage crops, potatoes, and hardy vegetables are the principal crops. Two cuttings of alfalfa are grown, which yield from 2 to 4 tons per acre on the older lands of the project and from 3 to 6 tons in the Tule Lake section. Wheat yields from 20 to 40 bushels, barley from 30 to 60 bushels, and potatoes from 125 to 250 sacks per acre where properly handled. The large area of cheap range land and the favorable climate combine to make the Klamath district preeminently a stock and dairy country. Very little loss occurs from stock diseases, and the proximity of immense forests and sawmills insures comparatively cheap lumber for barns and sheds. The open ranges, together with the national forest reserves in this section of the State, which provide summer pasture, give opportunity for farmers to maintain more stock for feeding at reasonable prices. Dairying is a profitable business and well suited to the district. There are five creameries and two cheese factories on the project. Various organizations, such as potato growers, poultry growers, and cow-testing associations, have been formed.

CANALS AND STRUCTURES

1. DOUBLE 16 FT ARCH CULVERT, ECHO CREEK FILL,
ECHO DAM SALT LAKE BASIN PROJECT UTAH
2. COMBINATION SECTION MAIN CANAL
KITTITAS DIVISION YAKIMA PROJECT · WASHINGTON
3 MORRISON CANYON SIPHON
KITTITAS DIVISION YAKIMA PROJECT WASHINGTON
4. DROP CANAL "A" TO CANAL "C"
KLAMATH PROJECT, OREGON-CALIFORNIA
5. SPILLWAY, EAST PARK DAM
ORLAND PROJECT CALIFORNIA
6 HEADWORKS OF "B" CANAL
GRAVITY DIVISION MINIDOKA PROJECT IDAHO

Klamath Falls is now on the main line of the Southern Pacific Railway over the Natron cut-off, which is the shortest and quickest route from Portland to San Francisco. The project is well supplied with highways. The Dalles-California Highway traverses the irrigated section from Klamath Falls to Malin in a southeasterly direction. The Klamath Falls-Lakeview Highway goes east through the Poe Valley section, while the Green Springs Mountain highway and the Crater Lake highway both give westerly connection with the Pacific-San Francisco to Portland Highway. These roads are all graveled highways and will soon have oil macadam surfaces. The Central Pacific line recently completed from Klamath Falls to Fernley, Nevada, gives direct connection with the central and Eastern States over easy grades and the Great Northern, already into Klamath Falls, will soon give another main line into San Francisco over the Western Pacific system.

The principal outside markets are Portland, Sacramento, and San Francisco. Much of the produce grown on the project finds a market in Klamath Falls and the near-by lumber camps.

Klamath Falls, Merrill, Malin, and Bonanza are project towns, the first named being the principal city in southern Oregon east of the Cascades. It has a population of approximately 16,000 and is the distributing center for a large territory.

Educational facilities are good, with 30 grade and 5 high schools. There are 9 churches in Klamath Falls and 6 on the project outside the city limits. Upper Klamath Lake and its tributary mountain streams make an attractive summer resort, with excellent boating and fishing. Lake of the Woods, Diamond Lake, Spring Creek, and Medicine Lake are popular resorts during the summer months. The nationally famed Crater Lake is 65 miles from Klamath Falls. Tule Lake is frequented during the fall and winter by large numbers of ducks and geese. Deer are quite plentiful in the timbered areas surrounding the project.

OREGON-IDAHO, OWYHEE PROJECT

THE Owyhee project, now under construction, extends 65 miles along the west side of Snake River at the western extremity of a very large and successful irrigated section in southern Idaho and eastern Oregon. Eighty-three thousand acres of the irrigable land lie in Oregon in the vicinity of Ontario, Nyssa, and Adrian, and 40,000 acres lie in Idaho adjacent to Homedale.

Ample transportation facilities are supplied by the Oregon Short Line Railroad and two of its branches, and all of the towns are connected by excellent highways.

The elevation of the project ranges from 2,200 to 2,600 feet. The temperature rarely goes below zero or above 100° F. the average

CANALS AND STRUCTURES

1. DOUBLE 16 FT. ARCH CULVERT, ECHO CREEK FILL, ECHO DAM SALT LAKE BASIN PROJECT UTAH
2. COMBINATION SECTION, MAIN CANAL KITTITAS DIVISION, YAKIMA PROJECT-WASHINGTON
3 MORRISON CANYON SIPHON KITTITAS DIVISION, YAKIMA PROJECT, WASHINGTON
4. DROP, CANAL "A" TO CANAL "C" KLAMATH PROJECT, OREGON-CALIFORNIA
5. SPILLWAY, EAST PARK DAM ORLAND PROJECT, CALIFORNIA
6 HEADWORKS OF "B" CANAL GRAVITY DIVISION MINIDOKA PROJECT IDAHO

Klamath Falls is now on the main line of the Southern Pacific Railway over the Natron cut-off, which is the shortest and quickest route from Portland to San Francisco. The project is well supplied with highways. The Dalles-California Highway traverses the irrigated section from Klamath Falls to Malin in a southeasterly direction. The Klamath Falls-Lakeview Highway goes east through the Poe Valley section, while the Green Springs Mountain highway and the Crater Lake highway both give westerly connection with the Pacific-San Francisco to Portland Highway. These roads are all graveled highways and will soon have oil macadam surfaces. The Central Pacific line recently completed from Klamath Falls to Fernley, Nevada, gives direct connection with the central and Eastern States over easy grades and the Great Northern, already into Klamath Falls, will soon give another main line into San Francisco over the Western Pacific system.

The principal outside markets are Portland, Sacramento, and San Francisco. Much of the produce grown on the project finds a market in Klamath Falls and the near-by lumber camps.

Klamath Falls, Merrill, Malin, and Bonanza are project towns, the first named being the principal city in southern Oregon east of the Cascades. It has a population of approximately 16,000 and is the distributing center for a large territory.

Educational facilities are good, with 30 grade and 5 high schools. There are 9 churches in Klamath Falls and 6 on the project outside the city limits. Upper Klamath Lake and its tributary mountain streams make an attractive summer resort, with excellent boating and fishing. Lake of the Woods, Diamond Lake, Spring Creek, and Medicine Lake are popular resorts during the summer months. The nationally famed Crater Lake is 65 miles from Klamath Falls. Tule Lake is frequented during the fall and winter by large numbers of ducks and geese. Deer are quite plentiful in the timbered areas surrounding the project.

OREGON-IDAHO, OWYHEE PROJECT

THE Owyhee project, now under construction, extends 65 miles along the west side of Snake River at the western extremity of a very large and successful irrigated section in southern Idaho and eastern Oregon. Eighty-three thousand acres of the irrigable land lie in Oregon in the vicinity of Ontario, Nyssa, and Adrian, and 40,000 acres lie in Idaho adjacent to Homedale.

Ample transportation facilities are supplied by the Oregon Short Line Railroad and two of its branches, and all of the towns are connected by excellent highways.

The elevation of the project ranges from 2,200 to 2,600 feet. The temperature rarely goes below zero or above 100° F. the average being 50° F., with very low humidity. The mean annual precipitation is 11 inches and the growing season averages 145 days.

Of the 123,000 acres embraced in the project it is planned to irrigate 100,000 acres by gravity from the Owyhee River and 11,000 acres by pumping from Snake River, while 12,000 acres are to be furnished with a supplemental storage supply from the Owyhee Reservoir. Of the 111,000 acres to be furnished with a complete supply 41,000 acres are now being irrigated by pumping from Snake River and 70,000 acres are undeveloped lands.

The Owyhee Dam serves the dual purpose of storing 715,000 acre-feet and diverting the gravity supply from the Owyhee River through tunnels and canals to the irrigable lands.

The irrigable lands for the most part are high bench lands with a good natural drainage. Their fertility has been well demonstrated. Under good management they are capable of producing high yields. The principal crops should be alfalfa, red clover, pasture, corn, potatoes, and the small grains, with small acreages devoted to apples, prunes, and some truck crops. The country is well adapted to dairying, with small flocks of sheep, swine, and poultry as secondary enterprises.

Most of the 70,000 acres of undeveloped land are in private ownership and contracts have been made with landowners requiring the sale of surplus land (tracts held in excess of 160 acres in one ownership) at prices fixed by independent appraisal. These prices vary from $5 to $15 an acre for irrigable land and from $1 to $2 an acre for nonirrigable land. Contracts have also been made with landowners of nonexcess lands (held in ownerships of 160 acres or less), providing that, if sales are made in excess of appraised value, one-half of such excess price shall be paid to the irrigation district to apply on the construction cost or other irrigation charges against the tract of land sold.

The construction of the Owyhee Dam and the two main tunnels is now (1930) under way, but it is not expected that water will be furnished to any of the lands prior to 1934.

SOUTH DAKOTA, BELLE FOURCHE PROJECT

THE Belle Fourche project is in the western part of South Dakota. The climate of this region is semiarid, with an average annual rainfall of 15 inches. The altitude is approximately 2,800 feet above sea level. The frost-free season averages about 130 days. Maximum summer temperatures seldom reach 100° F., but the long days of abundant sunshine during June, July, and August favor plant growth. Winter weather is generally mild, but is subject to sudden changes.

The water supply for the project is furnished by the Belle Fourche River, the flow of which is diverted through a 1,400 second-foot

VEGETABLES

1. TOMATOES
   SALT LAKE BASIN PROJECT, UTAH
2. ONIONS
   MINIDOKA PROJECT, IDAHO
3. IRRIGATED FARM PRODUCTS
   MILK RIVER PROJECT MONTANA
4. CANTALOUPES
   NEWLANDS PROJECT, NEVADA
5. WATERMELONS
   UMATILLA PROJECT, OREGON
6. PEAS
   UNCOMPAHGRE PROJECT, COLORADO

being 50° F., with very low humidity. The mean annual precipitation is 11 inches and the growing season averages 145 days.

Of the 123,000 acres embraced in the project it is planned to irrigate 100,000 acres by gravity from the Owyhee River and 11,000 acres by pumping from Snake River, while 12,000 acres are to be furnished with a supplemental storage supply from the Owyhee Reservoir. Of the 111,000 acres to be furnished with a complete supply 41,000 acres are now being irrigated by pumping from Snake River and 70,000 acres are undeveloped lands.

The Owyhee Dam serves the dual purpose of storing 715,000 acre-feet and diverting the gravity supply from the Owyhee River through tunnels and canals to the irrigable lands.

The irrigable lands for the most part are high bench lands with a good natural drainage. Their fertility has been well demonstrated. Under good management they are capable of producing high yields. The principal crops should be alfalfa, red clover, pasture, corn, potatoes, and the small grains, with small acreages devoted to apples, prunes, and some truck crops. The country is well adapted to dairying, with small flocks of sheep, swine, and poultry as secondary enterprises.

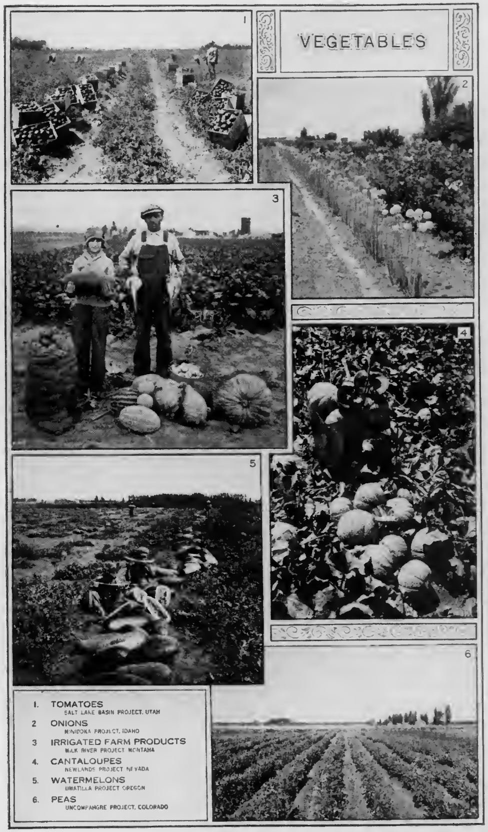
Most of the 70,000 acres of undeveloped land are in private ownership and contracts have been made with landowners requiring the sale of surplus land (tracts held in excess of 160 acres in one ownership) at prices fixed by independent appraisal. These prices vary from $5 to $15 an acre for irrigable land and from $1 to $2 an acre for nonirrigable land. Contracts have also been made with landowners of nonexcess lands (held in ownerships of 160 acres or less), providing that, if sales are made in excess of appraised value, one-half of such excess price shall be paid to the irrigation district to apply on the construction cost or other irrigation charges against the tract of land sold.

The construction of the Owyhee Dam and the two main tunnels is now (1930) under way, but it is not expected that water will be furnished to any of the lands prior to 1934.

SOUTH DAKOTA, BELLE FOURCHE PROJECT

THE Belle Fourche project is in the western part of South Dakota. The climate of this region is semiarid, with an average annual rainfall of 15 inches. The altitude is approximately 2,800 feet above sea level. The frost-free season averages about 130 days. Maximum summer temperatures seldom reach 100° F., but the long days of abundant sunshine during June, July, and August favor plant growth. Winter weather is generally mild, but is subject to sudden changes.

The water supply for the project is furnished by the Belle Fourche River, the flow of which is diverted through a 1,400 second-foot



VEGETABLES

1. TOMATOES
SALT LAKE BASIN PROJECT, UTAH
2 ONIONS
MINIDOKA PROJECT, IDAHO
3 IRRIGATED FARM PRODUCTS
MILK RIVER PROJECT MONTANA
4. CANTALOUPES
NEWLANDS PROJECT NEVADA
5. WATERMELONS
UMATILLA PROJECT OREGON
6. PEAS
UNCOMPAHGRE PROJECT, COLORADO

capacity canal into the Belle Fourche Reservoir. The capacity of the reservoir is adequate for all of the lands served. As now constructed, the irrigation system will deliver water to about 75,000 acres of land.

The surface topography of project lands is smooth but rolling, rendering expensive leveling unnecessary. Irrigation is effected by means of contour ditches and flooding. The predominating soil type is Pierre clay, locally known as gumbo, which comprises about two-thirds of the project area. This class of soil is very productive when properly farmed. The sandy loam types are more easily worked than the heavier soils but no more productive.

The principal crops are alfalfa, sugar beets, corn, and small grain. About 17,000 acres is in alfalfa, which yields about 2 tons per acre from three cuttings. This hay is fed largely to local livestock. Small grains yield well under favorable conditions, but should be rotated with cultivated crops for best results. Grains following sugar beets give very profitable yields. Feed of all kinds is available at reasonable cost and the opportunities for livestock and dairy farming are exceptionally favorable. During the past few years alfalfa in the stack has sold from $7 to $9 per ton, which leaves a good margin of profit when fed to dairy cows or sheep. The sheep industry is growing rapidly and nearly all resident farmers now have a flock of ewes or are fattening lambs for market. Wide expanses of open prairie lie to the north and east of the project, conveniently located for summer range, where sheepmen pasture their flocks at low cost.

A sugar factory was constructed at Belle Fourche in 1927 and all beets grown on the project are now made into sugar locally, which makes beet pulp available for livestock feeding. Seven to eight thousand acres of beets are grown on the Government project and this crop supplies the farmers with ready cash and opportunity to improve the soil for other crops.

Growing of cucumbers for pickles has developed as an important industry and all the towns on the project have salting stations. From 1 to 3 acres of this crop are grown on a great many farms and the returns generally range from $100 to $300 per acre.

Railroad transportation is provided by the Chicago & Northwestern Railway, the Chicago, Milwaukee & Pacific, and the Burlington. Together, these lines give a ready outlet to Omaha, Sioux City, Lincoln, Minneapolis, Denver, Billings, and the Northwest. Federal Highway No. 212, from Minneapolis to the Black Hills, traverses the project east and west and Federal Highway No. 79 runs through the project north and south. Both of these routes are improved roads, with graveled surface, which afford convenient travel to and from the Black Hills.

Newell has a population of 544 and is the principal town as well as project headquarters. Nisland, Fruitdale, and Vale are towns on the project. Belle Fourche, the county seat, has a population of about 2,029. The rural population on the project in 1929 was 2,300, and double that number could be supported. Newell has a new high school, and there are three similar institutions on the project. Grammar schools are ample for the needs of the communities. The Belle Fourche project offers adequate recreational advantages, with good roads leading to the Black Hills and other points of historic interest and scenic beauty.

UTAH, SALT LAKE BASIN PROJECT

THE Salt Lake Basin project comprises several natural divisions located in the drainage basin of the Great Salt Lake in the vicinity of Salt Lake City, Ogden, Provo, and Logan. The divisions are well settled and are served by canal systems which were constructed principally during the pioneer days of Utah. The water supply is ample in the early part of the irrigation season, but is deficient during the middle and late summer months on the divisions where storage reservoirs have not been constructed.

The Weber River division is the only unit of the project constructed to date. Its general elevation is from 4,200 to 6,500 feet above sea level. Although they vary slightly in different locations, the climatic conditions, are very healthful. More than 250 days in the year are clear and free from wind. The temperature range is between −10° and 95° F. The average annual precipitation is 16 inches and occurs largely between September 15 and June 1. The summers are fairly long and are favorable for the growing of many kinds of crops under irrigation. The average growing season between frosts amounts to 160 days.

The engineering features of the Weber River division include the Echo Dam, located in Weber Canyon 45 miles southeast of Ogden, and the Weber-Provo diversion canal, which connects the Weber to the Provo River about 20 miles upstream from the dam. The annual storage of the reservoir amounts to 74,000 acre-feet, and is used as a supplemental supply on about 60,000 acres of land in the Weber River Valley and on 17,000 acres in the Provo River watershed. The increased supply to the latter area is diverted from the Weber River through the Weber-Provo diversion canal in exchange for storage water. Because of the small amount of storage water diverted to the Provo River, further descriptions are confined to the Weber River area. All lands are in private ownership. The topography is smooth with favorable slopes for irrigation. The soils are mostly of the alluvial class and range from a sandy to a fine sandy loam, with occasional small areas of clay loam. They are very fertile, generally deep, and are easily tilled.

The principal crops of the division are sugar beets, fruits, vegetables, alfalfa, potatoes, berries, and grain. The average yield of all crops is high. Many vegetables and fruits, including tomatoes, peas, beans, cabbage (kraut), cherries, peaches, and apricots, are raised mainly for canning purposes. Tomatoes are also grown extensively for shipping to markets in other States both as "green wraps" and fresh for table use. In addition to the canned products, peaches, potatoes, apples, cherries, and onions are shipped to outside markets in carload lots.

Dairying and stock raising are important and profitable industries in the agricultural development. The near-by mountain ranges furnish summer pasture for many herds of cattle and sheep. Dairy cows are supported by small pastures on the farms. Both industries depend on alfalfa for winter feeding and consume the entire crop.

Many canning factories and packing houses for fruits and vegetables, sugar factories, and flour mills are provided at convenient locations. The Union Pacific & Southern Pacific Railroads connect the division directly with the Pacific coast and eastern markets. Local electric railroads traverse the farming areas and provide excellent transportation to local distributing points. Hard-surfaced highways and many oiled-surface crossroads are accessible to nearly all localities.

The principal cities and towns of the division are Ogden, Morgan, Layton, Clearfield, Hooper, and Plain City. Ogden is the railroad and business center and has a population of about 40,250. The population of the smaller cities and towns varies from 500 to 1,500 inhabitants.

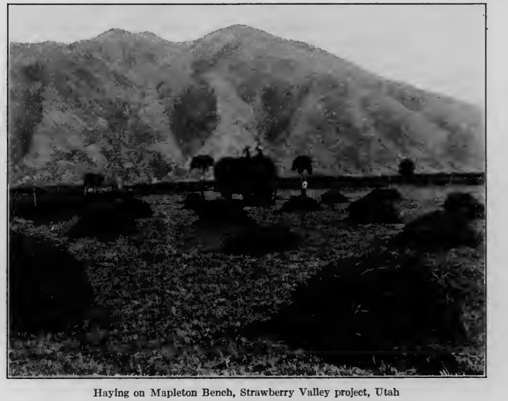
The cities and towns are well provided with educational facilities. School children in the farming districts are transported to and from school under a well-organized consolidated school system. High schools are available at convenient locations. The Smith-Hughes work and the 4-H Club work are very prominent in school activities. The State Agricultural College is located in Logan, 45 miles northeast, and the University of Utah in Salt Lake City 40 miles south of Ogden. Many of the principal religious denominations have organizations in Ogden and Salt Lake City. Fraternal organizations are also well represented in these cities.

The near-by canyons are attractive during the summer months, especially for fishing and picnicking. The public hunting grounds near the Bear River Migratory Bird Refuge and also other marshes bordering Great Salt Lake provide excellent duck shooting.

UTAH, STRAWBERRY VALLEY PROJECT

THE Strawberry Valley project is located in the north-central portion of Utah along the southeastern shore of Utah Lake. The elevation of the project lands is about 4,600 feet above sea level, and the average rainfall is 18½ inches, most of which occurs from September 1 to May 1. The climate is temperate, varying from 95° F. in summer to 0° F. in winter. The frost-free period averages 140 days.

Water for irrigation is obtained from the Strawberry and Spanish Fork Rivers and from smaller streams. The flood flow is stored in Strawberry Reservoir, carried through Strawberry Tunnel approximately 4 miles into Diamond Fork, and then diverted to the canal systems. The irrigation system serves a dual purpose in furnishing a full supply of water for about 20,000 acres, as well as a late supply for about 35,000 acres which previously were supplied inadequately during the months of July, August, and September. Some of the irrigable lands are rolling, and care must be taken for the best results in irrigation. The soil varies from sandy loam to heavy clay and to black alluvium. All soils are easily worked and extremely fertile.



Haying on Mapleton Bench, Strawberry Valley project, Utah

The crops grown are wheat, oats, onions, barley, alfalfa, timothy, sugar beets, potatoes, corn, apples, plums, pears, peaches, prunes, apricots, cherries, melons, and all kinds of vegetables. The sugar beet, cereal, and hay crops constitute the staple crops under the project. Three sugar factories are located on the project. Dairying

The principal crops of the division are sugar beets, fruits, vegetables, alfalfa, potatoes, berries, and grain. The average yield of all crops is high. Many vegetables and fruits, including tomatoes, peas, beans, cabbage (kraut), cherries, peaches, and apricots, are raised mainly for canning purposes. Tomatoes are also grown extensively for shipping to markets in other States both as "green wraps" and fresh for table use. In addition to the canned products, peaches, potatoes, apples, cherries, and onions are shipped to outside markets in carload lots.

Dairying and stock raising are important and profitable industries in the agricultural development. The near-by mountain ranges furnish summer pasture for many herds of cattle and sheep. Dairy cows are supported by small pastures on the farms. Both industries depend on alfalfa for winter feeding and consume the entire crop.

Many canning factories and packing houses for fruits and vegetables, sugar factories, and flour mills are provided at convenient locations. The Union Pacific & Southern Pacific Railroads connect the division directly with the Pacific coast and eastern markets. Local electric railroads traverse the farming areas and provide excellent transportation to local distributing points. Hard-surfaced highways and many oiled-surface crossroads are accessible to nearly all localities.

The principal cities and towns of the division are Ogden, Morgan, Layton, Clearfield, Hooper, and Plain City. Ogden is the railroad and business center and has a population of about 40,250. The population of the smaller cities and towns varies from 500 to 1,500 inhabitants.

The cities and towns are well provided with educational facilities. School children in the farming districts are transported to and from school under a well-organized consolidated school system. High schools are available at convenient locations. The Smith-Hughes work and the 4-H Club work are very prominent in school activities. The State Agricultural College is located in Logan, 45 miles northeast, and the University of Utah in Salt Lake City 40 miles south of Ogden. Many of the principal religious denominations have organizations in Ogden and Salt Lake City. Fraternal organizations are also well represented in these cities.

The near-by canyons are attractive during the summer months, especially for fishing and picnicking. The public hunting grounds near the Bear River Migratory Bird Refuge and also other marshes bordering Great Salt Lake provide excellent duck shooting.

UTAH, STRAWBERRY VALLEY PROJECT

THE Strawberry Valley project is located in the north-central portion of Utah along the southeastern shore of Utah Lake. The elevation of the project lands is about 4,600 feet above sea level, and the average rainfall is 18½ inches, most of which occurs from September 1 to May 1. The climate is temperate, varying from 95° F. in summer to 0° F. in winter. The frost-free period averages 140 days.

Water for irrigation is obtained from the Strawberry and Spanish Fork Rivers and from smaller streams. The flood flow is stored in Strawberry Reservoir, carried through Strawberry Tunnel approximately 4 miles into Diamond Fork, and then diverted to the canal systems. The irrigation system serves a dual purpose in furnishing a full supply of water for about 20,000 acres, as well as a late supply for about 35,000 acres which previously were supplied inadequately during the months of July, August, and September. Some of the irrigable lands are rolling, and care must be taken for the best results in irrigation. The soil varies from sandy loam to heavy clay and to black alluvium. All soils are easily worked and extremely fertile.

Haying on Mapleton Bench, Strawberry Valley project, Utah

The crops grown are wheat, oats, onions, barley, alfalfa, timothy, sugar beets, potatoes, corn, apples, plums, pears, peaches, prunes, apricots, cherries, melons, and all kinds of vegetables. The sugar beet, cereal, and hay crops constitute the staple crops under the project. Three sugar factories are located on the project. Dairying and poultry raising are extensively engaged in and are the most profitable and satisfactory enterprises of the district. The adjacent mountains and forest reserves form an excellent summer range for cattle and sheep, and the great deserts on the west are used for winter range. Bituminous coal is extensively mined in Carbon County, about 100 miles east of the project. Electrical energy from the Reclamation Bureau power house is available in all the project towns.

The project is traversed by two transcontinental railroad lines, the Denver & Rio Grande Western and the Los Angeles & Salt Lake (Union Pacific system). There is also a local electric interurban line connecting the main project towns with Salt Lake City and points in northern Utah. Excellent hard-surfaced roads connect the main project towns with Provo and Salt Lake City. Branch roads to the sugar factories, connecting with the main highways, have been hard surfaced, providing good transportation for sugar. Cooperative marketing associations are organized for the packing and sale of many products. Salt Lake City, Ogden, and smaller towns, and the mining districts constitute the principal local markets for most of the crops.

Provo, the county seat of Utah County, has a population of about 14,612 and is located about 8 miles north of the project. There are 12 towns in the district with an aggregate population of about 15,000. Excellent schools and educational facilities are provided in all project towns. Brigham Young University is located at Provo, the University of Utah at Salt Lake City, and the State Agricultural College at Logan. Excellent recreational advantages are offered at Salt Lake City and the mountain districts, which may be reached in a few hours by automobile.

WASHINGTON, OKANOGAN PROJECT

THE Okanogan project is located in north-central Washington, on the west side of the Okanogan River and about 50 miles south of the Canadian line. The elevation of the project lands is about 1,000 feet above sea level. The temperatures range between −10° and 108° F. The summers are hot and dry, but the heat is seldom oppressive and the nights are cool. Early and late frosts seldom interfere with the growth of crops.

The principal engineering features constructed by the Government are the Conconully and Salmon Lake Reservoirs, diversion weir and headworks, and the Robinson Flat pumping plant. There are also several privately constructed and privately financed high-lift pumping plants now pumping water from the Okanogan River onto the project lands. Some of these plants have maximum capacities of 6.5 to 7 second-feet under a 450 to 500 foot head.

The canal system, which is nearly all concrete lined, delivers water to each farm unit. Wells can be obtained on a large part of the project for domestic water supply and irrigation. Electricity is available for pumping and domestic uses.

The project embraces a total of about 5,600 irrigable acres. The lands are somewhat broken and the depth of soil will not permit much leveling, thus requiring an extensive system of farm laterals. The soil is volcanic ash, combined with a varying quantity of sand underlaid with sand and gravel, which affords excellent underdrainage and precludes the probability of seeped areas.

Nearly all the crops of the Temperate Zone can be grown here, but apples and alfalfa predominate. The irrigated land is planted principally to apple orchards. Soft fruit, berries, and garden truck can also be grown profitably. The average per acre yield of apples during the past 3 years was 285 boxes. The average yield of alfalfa is about 2.5 tons per acre. There are several warehouses on the project through which apples are shipped and supplies handled for the benefit of farmers. Apples are shipped all over the United States, and the export trade in this fruit is rapidly growing. The bulk of the other produce grown on the project is disposed of locally.

Reflections on Conconully Reservoir, Okanogan project, Washington

There are several sawmills and box factories in the vicinity of the project. Omak is the location of a fruit-dehydrating plant. A factory for the refinement of sodium salts, of which there are large deposits near-by, is located at Okanogan. Cold storage for perishables is available at Okanogan and Omak.

A branch line of the Great Northern Railway passing along the eastern border of the project, gives good passenger and freight service and poultry raising are extensively engaged in and are the most profitable and satisfactory enterprises of the district. The adjacent mountains and forest reserves form an excellent summer range for cattle and sheep, and the great deserts on the west are used for winter range. Bituminous coal is extensively mined in Carbon County, about 100 miles east of the project. Electrical energy from the Reclamation Bureau power house is available in all the project towns.

The project is traversed by two transcontinental railroad lines, the Denver & Rio Grande Western and the Los Angeles & Salt Lake (Union Pacific system). There is also a local electric interurban line connecting the main project towns with Salt Lake City and points in northern Utah. Excellent hard-surfaced roads connect the main project towns with Provo and Salt Lake City. Branch roads to the sugar factories, connecting with the main highways, have been hard surfaced, providing good transportation for sugar. Cooperative marketing associations are organized for the packing and sale of many products. Salt Lake City, Ogden, and smaller towns, and the mining districts constitute the principal local markets for most of the crops.

Provo, the county seat of Utah County, has a population of about 14,612 and is located about 8 miles north of the project. There are 12 towns in the district with an aggregate population of about 15,000. Excellent schools and educational facilities are provided in all project towns. Brigham Young University is located at Provo, the University of Utah at Salt Lake City, and the State Agricultural College at Logan. Excellent recreational advantages are offered at Salt Lake City and the mountain districts, which may be reached in a few hours by automobile.

WASHINGTON, OKANOGAN PROJECT

THE Okanogan project is located in north-central Washington, on the west side of the Okanogan River and about 50 miles south of the Canadian line. The elevation of the project lands is about 1,000 feet above sea level. The temperatures range between −10° and 108° F. The summers are hot and dry, but the heat is seldom oppressive and the nights are cool. Early and late frosts seldom interfere with the growth of crops.

The principal engineering features constructed by the Government are the Conconully and Salmon Lake Reservoirs, diversion weir and headworks, and the Robinson Flat pumping plant. There are also several privately constructed and privately financed high-lift pumping plants now pumping water from the Okanogan River onto the project lands. Some of these plants have maximum capacities of 6.5 to 7 second-feet under a 450 to 500 foot head.

The canal system, which is nearly all concrete lined, delivers water to each farm unit. Wells can be obtained on a large part of the project for domestic water supply and irrigation. Electricity is available for pumping and domestic uses.

The project embraces a total of about 5,600 irrigable acres. The lands are somewhat broken and the depth of soil will not permit much leveling, thus requiring an extensive system of farm laterals. The soil is volcanic ash, combined with a varying quantity of sand underlaid with sand and gravel, which affords excellent underdrainage and precludes the probability of seeped areas.

Nearly all the crops of the Temperate Zone can be grown here, but apples and alfalfa predominate. The irrigated land is planted principally to apple orchards. Soft fruit, berries, and garden truck can also be grown profitably. The average per acre yield of apples during the past 3 years was 285 boxes. The average yield of alfalfa is about 2.5 tons per acre. There are several warehouses on the project through which apples are shipped and supplies handled for the benefit of farmers. Apples are shipped all over the United States, and the export trade in this fruit is rapidly growing. The bulk of the other produce grown on the project is disposed of locally.

Reflections on Conconully Reservoir, Okanogan project, Washington

There are several sawmills and box factories in the vicinity of the project. Omak is the location of a fruit-dehydrating plant. A factory for the refinement of sodium salts, of which there are large deposits near-by, is located at Okanogan. Cold storage for perishables is available at Okanogan and Omak.

A branch line of the Great Northern Railway passing along the eastern border of the project, gives good passenger and freight service and connects with the main line at Wenatchee, Wash., 100 miles south. Motor passenger busses make trips twice daily from Wenatchee to Oroville on the Canadian boundary, and return. A State and Federal aid hard-surfaced highway runs through the edge of the project and hard-surfaced roads penetrate to all parts of the project.

Project towns are Okanogan, Omak, and Riverside. Okanogan is the county seat of Okanogan County and has a population of about 1,500. Omak, on the project's eastern edge, has a reputed population of about 2,500. Riverside, on the northern edge of the project, has a population of about 220. School facilities are excellent. Okanogan and Omak have grammar and accredited high schools. Children are transported in busses to these central consolidated schools, where better facilities are available than in small country schools. Many of the religious denominations are represented in the towns.

The country surrounding the project is mountainous and mainly forest covered. There are many places within a short distance of the project where fishing and hunting may be enjoyed.

WASHINGTON, YAKIMA PROJECT

THE Yakima project is located in south-central Washington, in the valley of the Yakima River on the eastern slope of the Cascade Mountains. It is made up of seven natural divisions, of which the Tieton, of 31,000 acres, and the Sunnyside, of 102,500 acres, have been constructed. The Wapato division, containing 120,000 acres on the Yakima Indian Reservation, is being constructed by the Bureau of Indian Affairs, with 90,000 acres now under cultivation. The total area in the valley that may eventually be irrigated is about 600,000 acres.

The climate is mild, with little precipitation, but with occasional cold snaps. The summers are warm, with a frost-free season of about 150 days. The annual rainfall varies from 6 to 8 inches. The elevation of the irrigable area ranges from 700 feet above sea level on the Sunnyside division to 2,100 feet on the Tieton division.

The irrigated lands receive their water supply from the Yakima River and its tributaries, which rise in the snow-covered mountains of the Cascade Range. Five storage reservoirs, Keechelus, Kachess, Clear Creek, Bumping, and Tieton, have been completed, as have the irrigation systems for the Sunnyside and Tieton divisions, and the construction of the sixth reservoir, Cle Elum, was begun in 1930.

The soils of both the Sunnyside and Tieton divisions are generally of a fine silty texture, locally known as volcanic ash. They are deep, fertile, easily tilled, and well adapted to almost all Temperate Zone crops. The character of the topography is generally rolling and irrigation is carried on mainly by the furrow system. Fruits, more particularly apples, potatoes, and alfalfa, are the principal products. Wheat, corn, vegetables, and berries are also important crops. Alfalfa produces from 3 to 6 tons per acre.

The open, dry winters favor the breeding and development of livestock of all classes. Hogs are grown for the coast market, a considerable number of cattle are raised and fattened here, and thousands of sheep from the range are driven in to the project, some for winter quarters and some for fattening. Dairying and poultry raising are extensive and profitable, and are carried on under favorable conditions.

The project supports about 60 industries, including canneries, creameries, fruit-evaporating plants, meat-packing plants, spray, grape juice, and cheese factories, etc. Cold-storage facilities are afforded by plants having a combined capacity of approximately 10,000 cars.

The main line of the Northern Pacific Railroad passes through a portion of the Sunnyside division, with branch lines adequately serving both the Tieton and Sunnyside divisions, and the Union Pacific connects Kennewick and Yakima. Shipping stations are only a few miles distant from the individual farms. A paved State highway extends 45 miles down the valley from Yakima through the Sunnyside division and an excellent gravel highway runs to Ellensburg, connecting this project with the National Parks Highway, which extends to Seattle. The market for the extensive fruit crops is furnished mainly by the large cities in the interior and the East; the Pacific coast cities provide an outlet for the surplus forage, grain crops, and livestock.

Yakima is the business center and principal city in the Yakima Valley and has a population of about 22,000. There are 18 smaller towns on the project, with a combined population of 9,300, and the farming population is about 14,000. There are 51 school districts on the project, with 10 consolidated schools and 15 accredited high schools. There are two business colleges in Yakima, and a junior college was established there in 1928.

The Yakima Valley is only a few hours' ride from the most picturesque sections of the Cascades, and Mount Rainier or Mount Adams, with their glaciers and perpetual snow, may be reached with less than a day's drive.

Kittitas division.—The Kittitas division is located in the Yakima River Valley, Kittitas County. Ellensburg, the county seat of Kittitas County and center of the project, is about 115 miles southeast of Seattle, 35 miles north of Yakima, and 194 miles west of Spokane. Usually yearly variations in temperature range from a maximum of 100° to a minimum of −2° F. The irrigation season lasts from about

April 20 to October 1—164 days. The mean annual precipitation is 9.62 inches, most of which occurs during the winter season. The elevation of the irrigable lands in the valley varies from 1,500 to 2,200 feet above sea level.

The water supply is obtained from the natural flow of the Yakima River, supplemented by stored water from Keechelus and Kachess Reservoirs, and is diverted from the Yakima River by a concrete diversion dam constructed just above the town of Easton. From Easton the main canal runs easterly for 25 miles along the south side of the Yakima River to a point about 8 miles up the river from the town of Thorp, where the canal divides, the north branch crossing the river and completely encircling the Kittitas Valley on the north, east, and southeasterly sides, and the south branch encircling the valley on the west and southwesterly sides.

Sugar beets grown on an irrigated farm

The irrigation works are designed to irrigate approximately 72,000 acres of land. The country is rolling, with considerable slope toward the Yakima River. The soils are variable in texture and composition, but volcanic ash, alluvial loam, silt, and sandy loam predominate. Water was available in 1930 for about 2,000 acres of land under the main canal and about 11,300 acres under the south branch canal. It is estimated that during the calendar year 1931, water will be available for an additional area of 20,000 acres of land under the north branch canal.

Although a considerable portion of the lands in the project were farmed prior to 1930, there has never been an adequate supply of water available. However, about 26,000 acres of the lower lands of the valley have been farmed successfully for many years, the irrigation water being obtained from privately owned canals having water rights to natural flow of the Yakima River, supplemented by storage from Government reservoirs. The principal crops grown on these lands are alfalfa, cereals, root crops, potatoes, fruit, and vegetables. The alfalfa yields vary from 2½ to 5 tons, with an average yield of about 3 tons per acre; potatoes from 10 to 20 tons, average 12 tons; oats from 60 to 100 bushels, average 75 bushels; and wheat from 30 to 75 bushels, average 45 bushels. In 1929 apples yielded an average of about 240 boxes of graded fruit per acre. The Kittitas division is composed principally of the higher lands around the outer part of the valley, and generally similar crops will be grown on project lands. At present dairying is an important industry in the valley, and this industry will increase as new lands are brought under irrigation. Large numbers of range stock are brought into the valley for winter feeding from surrounding mountain ranges where summer pasture is usually good.

The project is traversed by two transcontinental railroads—the Northern Pacific and the Chicago, Milwaukee, St. Paul & Pacific. No part of the project, except a small area in Badger Pocket, is more than 7 miles from a shipping point. Puget Sound ports furnish good markets. Good roads cover all parts of the valley, with concrete pavement connecting Ellensburg with the towns of Kittitas and Thorp. The project is also traversed by the State highways to Spokane, Seattle, Wenatchee, and Yakima.

The project towns are Ellensburg, with a population of about 5,000; Cle Elum about 2,500; Roslyn, 863; Thorp, 300; Kittitas, 244; and Easton, 300. The school facilities are excellent, all of the towns having grammar and high schools. The Washington State Normal, with an enrollment of about 1,100, is located at Ellensburg. It is only about a two hours' drive from Ellensburg over good State roads to Lakes Kachess, Keechelus, and Cle Elum in the heart of the Cascade Mountains, where boating, fishing, and swimming are popular pastimes and the surrounding mountains offer many attractions to the lovers of outdoors in the way of mountain climbing, hunting, fishing, and camping. Seattle and Puget Sound points can be reached in four or five hours easy driving on the surfaced State highway over the scenic Cascade Mountains.

April 20 to October 1—164 days. The mean annual precipitation is 9.62 inches, most of which occurs during the winter season. The elevation of the irrigable lands in the valley varies from 1,500 to 2,200 feet above sea level.

The water supply is obtained from the natural flow of the Yakima River, supplemented by stored water from Keechelus and Kachess Reservoirs, and is diverted from the Yakima River by a concrete diversion dam constructed just above the town of Easton. From Easton the main canal runs easterly for 25 miles along the south side of the Yakima River to a point about 8 miles up the river from the town of Thorp, where the canal divides, the north branch crossing the river and completely encircling the Kittitas Valley on the north, east, and southeasterly sides, and the south branch encircling the valley on the west and southwesterly sides.

Sugar beets grown on an irrigated farm

The irrigation works are designed to irrigate approximately 72,000 acres of land. The country is rolling, with considerable slope toward the Yakima River. The soils are variable in texture and composition, but volcanic ash, alluvial loam, silt, and sandy loam predominate. Water was available in 1930 for about 2,000 acres of land under the main canal and about 11,300 acres under the south branch canal. It is estimated that during the calendar year 1931, water will be available for an additional area of 20,000 acres of land under the north branch canal.

Although a considerable portion of the lands in the project were farmed prior to 1930, there has never been an adequate supply of water available. However, about 26,000 acres of the lower lands of the valley have been farmed successfully for many years, the irrigation water being obtained from privately owned canals having water rights to natural flow of the Yakima River, supplemented by storage from Government reservoirs. The principal crops grown on these lands are alfalfa, cereals, root crops, potatoes, fruit, and vegetables. The alfalfa yields vary from 2½ to 5 tons, with an average yield of about 3 tons per acre; potatoes from 10 to 20 tons, average 12 tons; oats from 60 to 100 bushels, average 75 bushels; and wheat from 30 to 75 bushels, average 45 bushels. In 1929 apples yielded an average of about 240 boxes of graded fruit per acre. The Kittitas division is composed principally of the higher lands around the outer part of the valley, and generally similar crops will be grown on project lands. At present dairying is an important industry in the valley, and this industry will increase as new lands are brought under irrigation. Large numbers of range stock are brought into the valley for winter feeding from surrounding mountain ranges where summer pasture is usually good.

The project is traversed by two transcontinental railroads—the Northern Pacific and the Chicago, Milwaukee, St. Paul & Pacific. No part of the project, except a small area in Badger Pocket, is more than 7 miles from a shipping point. Puget Sound ports furnish good markets. Good roads cover all parts of the valley, with concrete pavement connecting Ellensburg with the towns of Kittitas and Thorp. The project is also traversed by the State highways to Spokane, Seattle, Wenatchee, and Yakima.

The project towns are Ellensburg, with a population of about 5,000; Cle Elum about 2,500; Roslyn, 863; Thorp, 300; Kittitas, 244; and Easton, 300. The school facilities are excellent, all of the towns having grammar and high schools. The Washington State Normal, with an enrollment of about 1,100, is located at Ellensburg. It is only about a two hours' drive from Ellensburg over good State roads to Lakes Kachess, Keechelus, and Cle Elum in the heart of the Cascade Mountains, where boating, fishing, and swimming are popular pastimes and the surrounding mountains offer many attractions to the lovers of outdoors in the way of mountain climbing, hunting, fishing, and camping. Seattle and Puget Sound points can be reached in four or five hours easy driving on the surfaced State highway over the scenic Cascade Mountains.

WYOMING, RIVERTON PROJECT

THE Riverton project, now under construction, will irrigate a tract of land in excess of 100,000 acres lying north of Wind River and west of the Big Horn River. The Pilot Butte Reservoir, with a capacity of 30,000 acre-feet, has been completed and the Bull Lake Reservoir, with a capacity of over 100,000 acre-feet, will be constructed when needed.

The waters of Wind River are diverted into the Wyoming Canal, with capacity of 2,200 second-feet, at a point 35 miles above Riverton by a concrete structure known as the Wind River diversion dam. This dam and 17 miles of the Wyoming Canal and the lateral system under this portion of the canal covering 20,000 acres have been completed. By the fall of 1930, about 26 miles of the Pilot Canal were completed, together with the lateral system under this portion of the canal, covering an additional area of about 15,000 acres. A hydro-electric power plant with a capacity of 2,400 horsepower has been constructed at mile 9 of the Wyoming Canal. Power from this plant is being used in the construction of the project and surplus power is available for sale.

Home of a new settler on the Riverton project, Wyoming

The soil ranges from a sandy loam to a clay loam. The average annual rainfall is 9 inches and the frost-free period approximately 140 days. The average altitude is about 5,200 feet above sea level. Soil and climatic conditions are well suited for the production of alfalfa, cereals, potatoes, sugar beets, and vegetables, and in general for any crop which can be grown in the northern part of the United States. Conditions are well adapted for the raising and feeding of cattle, sheep, hogs, and poultry.

Pavillion is a small town located on the project. The nearest railroad points are Riverton and Shoshoni, on the Chicago & North Western Railroad. Two Federal-aid highways traverse the project. Yellowstone Park and the Teton Mountains are within 150 miles. Some of the best hunting and fishing in the United States are within two or three hours' drive. Both oil and natural gas are produced near by and coal of a good quality is available at several local mines. Water of an excellent quality can usually be obtained at a depth of 100 to 350 feet. There is a well-equipped creamery at Riverton, and several cooperative marketing associations have their headquarters there.

Sixty farm units of public land have been opened to homestead entry, of which a considerable number are still available. Water is now available for additional public land which will be opened to settlement when there is a demand. Private land, mostly unimproved is for sale at low prices and on reasonable terms.

WYOMING, SHOSHONE PROJECT

THE Shoshone project is located in the northwestern part of Wyoming, near the Yellowstone National Park. The climate is healthful and exhilarating. The maximum recorded temperature is 101° and the minimum −34° F. The frost-free season extends from about May 28 to September 19. The average rainfall is 5½ inches, and the average elevation is 4,500 feet above sea level.

There are many interesting engineering features on this project, among which are the Shoshone Dam, a rubble concrete arch 328 feet high placed across the Shoshone River about 8 miles above Cody, Wyo., that makes a lake 10 square miles in area and provides 456,000 acre-feet of storage; the Corbett diversion dam; the Corbett Tunnel; the Willwood diversion dam, 68 feet high; a power plant at Shoshone Dam; and a very complete canal and lateral system now constructed covering 72,000 acres.

With a mean annual flow of 1,090,000 acre-feet, the river furnishes an ample water supply. Water for domestic use is obtained either from shallow wells or from the canals. Some settlers have cisterns that are filled from the canals for a winter water supply. The topography of the land in general is suitable for irrigation without prohibitive leveling costs. The soils of the project are varied, some sections having clay soil with a subsoil of coarse gravel; while in other sections soil of the sandy loam type predominates.

The principal crops are alfalfa, beans, sugar beets, potatoes, and grain. Beans, both for seed and the Great Northern variety for table use, are one of the best money-making crops. There is an up-to-date seed company on the project, with a cleaning plant and modern facilities for handling bean and pea seed. Small fruits, berries, and truck do well and are grown for local consumption and for the park tourist trade. The climate and compact settlement of the project are favorable for dairying and poultry raising, and many of the successful farmers have these industries as the backbone of their farming operations. Turkeys also do exceptionally well on account of the dry climate, and represent an important part of the farmer's program. Feeder hogs are extensively raised, and thousands of lambs are fattened on the project for market every year. The foothills produce an abundance of summer pasture for range stock, which affords a market for surplus feed grown under irrigation.

Peas in shock, Shoshone project, Wyoming

The main line of the Chicago, Burlington & Quincy Railroad runs through the eastern part of the Frannie division, a spur from the main line runs through the heart of the project to Cody, Wyo., and the park to park highway passes through Powell and Cody, giving a direct route to the Yellowstone National Park. The principal markets for grain, potatoes, and fat livestock are Kansas City, Omaha, and the South. The local demand consumes most of the forage and dairy products. Sugar beets go to Billings, Mont., and Lovell, Wyo.

Powell, with a population of 1,156, is the principal town, and Deaver and Frannie are smaller railway stations. Billings, Mont., is the nearest city of much importance. Consolidated schools exist at Deaver and Powell and serve nearly all the project and some of the adjacent communities. Powell has an accredited high school with a Smith-Hughes course in agriculture. There are 10 fraternal and 17 social organizations and 7 churches on the Garland division. On the Frannie division there are 4 fraternal and 3 social organizations and 2 churches. The Willwood division has an active community club.

The Yellowstone National Park is a half day's drive from Powell. Many other interesting places can be reached over good roads by those seeking recreation.

The new Willwood division of the project has 12,000 acres of irrigable land. In the spring of 1930 there were 70 farm units available for homestead entry under the selective settlement plan. This division offers a very attractive proposition to young men desirous of owning farm homes.

The principal crops are alfalfa, beans, sugar beets, potatoes, and grain. Beans, both for seed and the Great Northern variety for table use, are one of the best money-making crops. There is an up-to-date seed company on the project, with a cleaning plant and modern facilities for handling bean and pea seed. Small fruits, berries, and truck do well and are grown for local consumption and for the park tourist trade. The climate and compact settlement of the project are favorable for dairying and poultry raising, and many of the successful farmers have these industries as the backbone of their farming operations. Turkeys also do exceptionally well on account of the dry climate, and represent an important part of the farmer's program. Feeder hogs are extensively raised, and thousands of lambs are fattened on the project for market every year. The foothills produce an abundance of summer pasture for range stock, which affords a market for surplus feed grown under irrigation.

Peas in shock, Shoshone project, Wyoming

The main line of the Chicago, Burlington & Quincy Railroad runs through the eastern part of the Frannie division, a spur from the main line runs through the heart of the project to Cody, Wyo., and the park to park highway passes through Powell and Cody, giving a direct route to the Yellowstone National Park. The principal markets for grain, potatoes, and fat livestock are Kansas City, Omaha, and the South. The local demand consumes most of the forage and dairy products. Sugar beets go to Billings, Mont., and Lovell, Wyo.

Powell, with a population of 1,156, is the principal town, and Deaver and Frannie are smaller railway stations. Billings, Mont., is the nearest city of much importance. Consolidated schools exist at Deaver and Powell and serve nearly all the project and some of the adjacent communities. Powell has an accredited high school with a Smith-Hughes course in agriculture. There are 10 fraternal and 17 social organizations and 7 churches on the Garland division. On the Frannie division there are 4 fraternal and 3 social organizations and 2 churches. The Willwood division has an active community club.

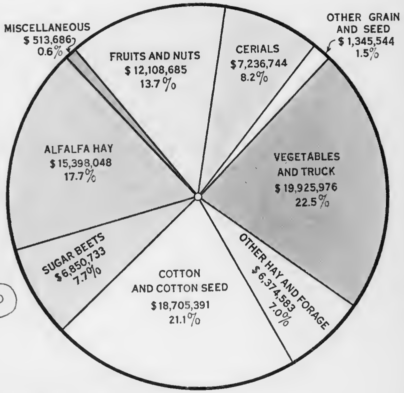
The Yellowstone National Park is a half day's drive from Powell. Many other interesting places can be reached over good roads by those seeking recreation.

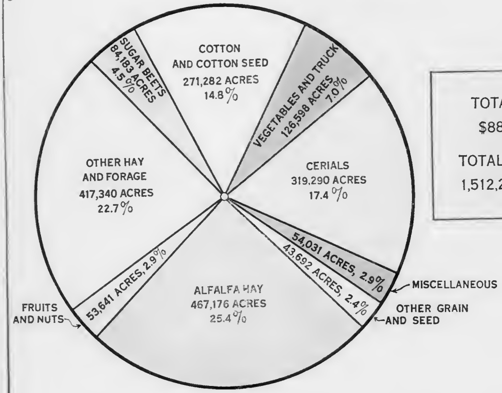
The new Willwood division of the project has 12,000 acres of irrigable land. In the spring of 1930 there were 70 farm units available for homestead entry under the selective settlement plan. This division offers a very attractive proposition to young men desirous of owning farm homes.

FEDERAL IRRIGATION PROJECTS

DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

VALUE AND ACREAGE
OF
IRRIGATED CROPS
1929





TOTAL VALUE
$88,459,390

TOTAL ACREAGE
1,512,250 ACRES

ADDITIONAL LAND, 1,192,990 ACRES, RECEIVING PROJECT WATER UNDER WARREN ACT CONTRACTS, PRODUCED CROPS VALUED AT
$72,720,490

Nº 21620-A

END OF
TITLE